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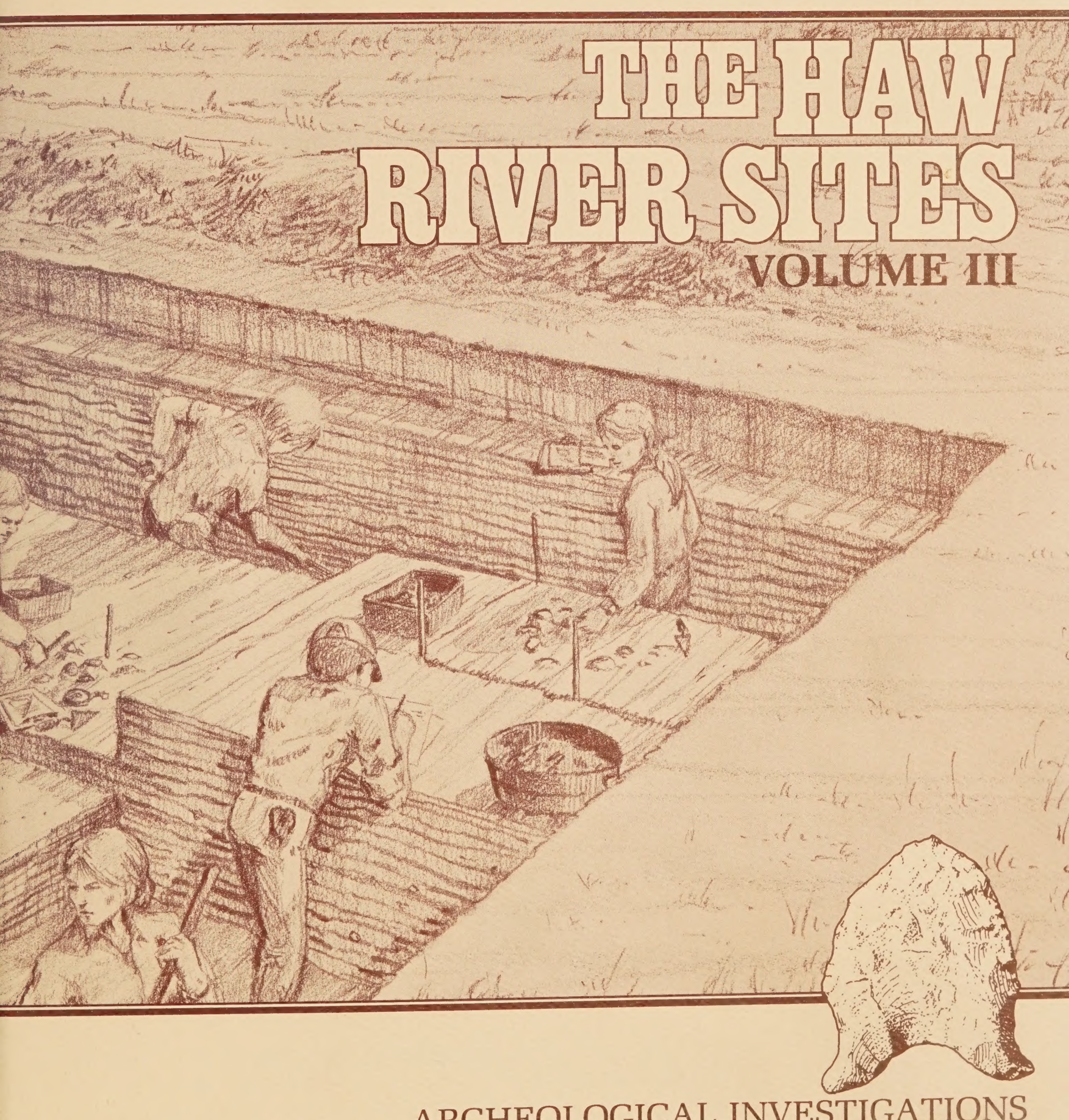
THE HAW RIVER SITES

VOLUME III



ARCHEOLOGICAL INVESTIGATIONS
AT TWO STRATIFIED SITES
IN THE NORTH CAROLINA PIEDMONT

CLAGGETT & CABLE, ASSEMBLERS
COMMONWEALTH ASSOCIATES, INC.

THE HAW RIVER SITES:

ARCHEOLOGICAL INVESTIGATIONS AT TWO STRATIFIED SITES IN THE NORTH CAROLINA PIEDMONT

VOLUME III

STEPHEN R. CLAGGETT AND JOHN S. CABLE,

ASSEMBLERS

UNDER THE SUPERVISION OF

CURTIS E. LARSEN, Ph.D.

PRINCIPAL INVESTIGATOR

Curtis E Larsen

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CHAPTER 10
DESCRIPTION AND ANALYSIS OF CERAMIC ASSEMBLAGES

Details of procedures used to address technological and stylistic variability in prehistoric ceramics from site 31Ch8 were presented in Chapter 4. A review of current knowledge on the Woodland and late prehistoric Piedmont occupations also has been provided as a reference along with descriptions of ceramic types known to commonly occur in the region.

This report section addresses the results of the analysis of ceramics recovered from 31Ch8. Individual sub-sections deal with the technological analysis of ceramic production procedures and a statistically-based treatment of ceramic attributes that subsumes both technologic and stylistic attributes of the recovered sherd samples.

Technological Analysis of Haw River Ceramics

These analytic procedures outlined in Chapter 4 suggested six distinct groupings of Haw River ceramics. These groups, or *technological types*, may be summarized as follows.

T-I Specimens of this type are thick sherds (ca. 10-12 mm thick) and evidently portions of larger vessels. Their color and oxidation state are highly variable – red to orange/ buff to gray – and thus not good indicators of this type. The sherds are dense and hard, of fine-grained and well-mixed clay. Organic matter (by contributing alkalis, hence lowering the fusion point) may be responsible for fluxing and the incipient vitrification observed in these sherds. Inclusions are relatively large fragments of quartz and other silicates, although there is some range in size. The quartz fragments appear crushed, judging by the degree of angularity, and are probably size sorted. These inclusions were probably deliberately added to reduce shrinkage of the fabric to a manageable level. Smaller inclusions of feldspar and other silicates are also present as naturally occurring sand in the clay. There is surface decoration of some sort on all sherds of this type although this does not seem to have significantly affected the technical characteristics of the pottery. Porosity is moderate, with pores being compressed and elongated parallel to the surface, suggesting extensive smoothing or surface treatment to compress the subsurface clay.

T-II These are large surface-decorated sherds of medium thickness (ca. 6-8 mm thick). The fabric is strong and hard, as is suggested by the presence of many large vessel fragments. Surface and core color are variable, possibly reflecting variation in the oxidation state, although the blackened core in some examples may be the result of carbon deposition from organic matter in the clay. The mixing of the clay is fair to poor although the pottery

seems generally strong. Surface decoration may add to the strength of the pot by compression of the clay near the surface, and may, by the same means, affect the permeability of the fabric, and, thus, its oxidation state, since oxygen would be prevented from reaching the core by the compressed subsurface clay. Large inclusions of crushed quartz are present in these sherds. Relatively large amounts of sand also occur; in addition to quartz particles, this sand is composed of feldspars and other silicates, including mica.

T-III Sherds in this category are thin (ca. 4-5 mm) and very hard and tough. The color is highly variable (black to red) and may reflect oxidation state which varies from one part of the pot to another. The clay is well-mixed. This, together with the effect of surface decoration, if any, may account for the observed hardness and toughness. Inclusions of crushed quartz are fairly large relative to the thickness of the sherds, a characteristic which should counteract the contribution of clay mixture to greater strength. A sand of mixed silicates including feldspars and black scoraceous material is the dominant inclusion type.

T-IV These are relatively thin (ca. 6-7 mm. thick) sherds of a uniform, hard, fine-grained, and well-mixed clay. The color is gray/black and may be taken, in the absence of quantities of organic matter, as indicating a reduced fabric. The sherds are undecorated. Inclusions are small fragments of silicates including feldspar and quartz. The pottery is clearly distinct from the other types in appearance and physical properties.

T-V Very thin (3-4 mm) but large sherds of high quality with a uniform texture. The small to medium size inclusions of quartz and feldspar may be considered naturally occurring fine sand. The few examples present are gray in core and interior with a buff exterior. The large size of the sherds and their evident hardness and strength imply a quality of ceramic superior to the other pottery of the sample.

T-VI An anomalous category, consisting of a few examples of a sandy, soft ware of various thicknesses. They are sandy to the point of being crumbly; some are hardly more than a loose mixture of mud and sand. The sand is almost certainly natural, since it is difficult to imagine adding this much sand as temper.

A degree of correspondence may be established between the technological types emerging from this analysis, the descriptive ceramic categories presented in the literature of North Carolina prehistory, and the individual vessels excavated from Haw River site 31Ch8. These vessels are described below. Table 3 in Appendix 3 gives sherd — specific data for each of the vessels. Individual vessel provenience:

Vessel I Block C — Excavation Unit 5 — Square 8 — Level 4 — Feature 12 — n = 12 (ID numbers 368-379 in Appendix 3, Table 3)

Vessel II Block C — Excavation Unit 6 — Square 8 — Level 4 — Feature 7 — See Figure 7.13 — n = 38 (ID numbers 380-417 in Appendix 3, Table 3)

Vessel III Block C – Excavation Unit 7 – Square 1 – Levels 4-8 – Feature 5 – See Figure 7.12 – n = 90 (ID numbers 418-507 in Appendix 3, Table 3)

Vessel IV Block C – Excavation Unit 7 – Square 1 – Levels 4-8 – Feature 5 – See Figure 7.12 – n - 99 (ID numbers 515-613 in Appendix 3, Table 3)

Vessel V Block B – Excavation 3 – Feature 15 – n = 25 (ID numbers 614-638 in Appendix 3, Table 3)

Vessel I – Sherds from this proto-historic/historic vessel are uniformly thin and hard. They exhibit a compact lamellar structure in cross-section and are distinctly granular in texture. Inclusions are quartz, mica, hornblende, and other silicates – all of sand size. Surface and interior coloration suggest great variability in the firing atmosphere. The vessel has net-impressed decoration on the exterior surface and a smoothed interior surface. The rim profile is straight; the lip has an undulating pinched form.

Vessel II – This Badin vessel is thicker in section than Vessel I, with a fabric that, although softer and more porous than Vessel I, is relatively hard and durable. Some fairly large inclusions occur, but most are of sand size or smaller. Exterior surface decoration consists of random cord-marked overstamping which has been partially smoothed; the interior has also been smoothed. The vessel has a straight rim and rounded lip.

Vessel III – This vessel is of a typical Yadkin cord-impressed ware. Sherds are generally large and have fractured along coil lines. The fabric indicates considerable and imperfect mixture. Inclusions are large and varied in type, with feldspars predominant. Exterior surface decoration is clear and distinct; overstamping was applied in the same general direction. The interior surface of the vessel is smoothed. The rim is straight in profile, and the square lip exhibits cord-markings.

Vessel IV – This vessel is the Yadkin fabric-impressed counterpart of Vessel III. The clear fabric decoration appears on the exterior surface as well as on the upper portions of the interior. The remaining portion of the interior has been smoothed. The rim is straight and slightly tapered in profile, with parallel markings on the interior surface immediately below the lip. The square lip is also fabric-impressed.

Vessel V – The relatively large pieces of crushed quartz inclusions in this vessel are typically Uwharrie; however, the vessel walls are thinner than typical Uwharrie specimens observed at the Archeology Laboratories of UNC-Chapel Hill. The exterior surface decoration of this vessel is distinctive – "sloppy" elongated linear check stamped impressions. An incised line and row of point punctations appear parallel to the lip. A sherd cross-section shows a distinct reddish oxidized layer beneath and including the exterior surface. The interior surface has been smoothed with a serrated tool. The attributes of wall thickness and surface decoration suggest that this vessel is a later Uwharrie variant.

Technological Type I (T-I) corresponds to typical Uwharrie pottery. Large crushed quartz inclusions which have been deliberately added to the paste are characteristic, although other silicates including feldspar occur. In contrast to McCormick(1970) and Wilson (1976), these sherds are not noted to be "highly" or "unusually friable." Vessel V from 31Ch8, Block B, is representative of this ceramic category (Figure 10.1).

Technological Type II (T-II) sherds fall into the standard Yadkin pattern, with larger quantities of inclusions (crushed quartz and sand) and a fairly porous fabric of poorly mixed clays. Vessels III and IV from 31Ch8, Block C, are examples of this category (See Figure 10.1 and the description of cultural Feature 5 in Chapter 7).

Technological Type III (T-III) sherds are typically Badin in their sandy texture and hardness. Both the sand and occasional larger silicate inclusions may be natural elements of the clay used in manufacture of these vessels. Vessel II from Excavation Unit 6 in 31Ch8 is a typical Badin vessel (Figure 10.1).

Technological Type IV (T-IV) represents distinctly better-made vessels having a fine-grained texture characteristic of late proto-historic and historic pottery. Descriptions of Hillsboro pottery appearing in the literature compares favorably with attributes defining T-IV sherds (Figure 10.1).

Technological Type V (T-V) sherds are somewhat difficult to assign unambiguously to established pottery types. They are thin and hard, with a granular surface texture, indicating proto-historic or historic technological themes. This technological type is represented by a single vessel, Vessel I, from 31Ch8 (Figure 10.1, and the discussion of Feature 12 in Chapter 7).

Technological Type VI (T-VI) sherds, sandy and crumbly in texture, seem to antedate Badin technology. Smith's New Hope Rough Plain category closely resembles this technological type (Figure 10.1).

Statistical Analysis of Haw River Ceramics

The statistical procedures applied to a sample of Haw River area pottery have been presented in Chapter 5. Discussion of analysis and results begins with the sixteen groups of co-occurring variables which were identified from inspection of bivariate association coefficients (phi and Jaccards's).

(1) small exterior cord marking
flattened lip profile
level lip
cord marked lip
straight rim

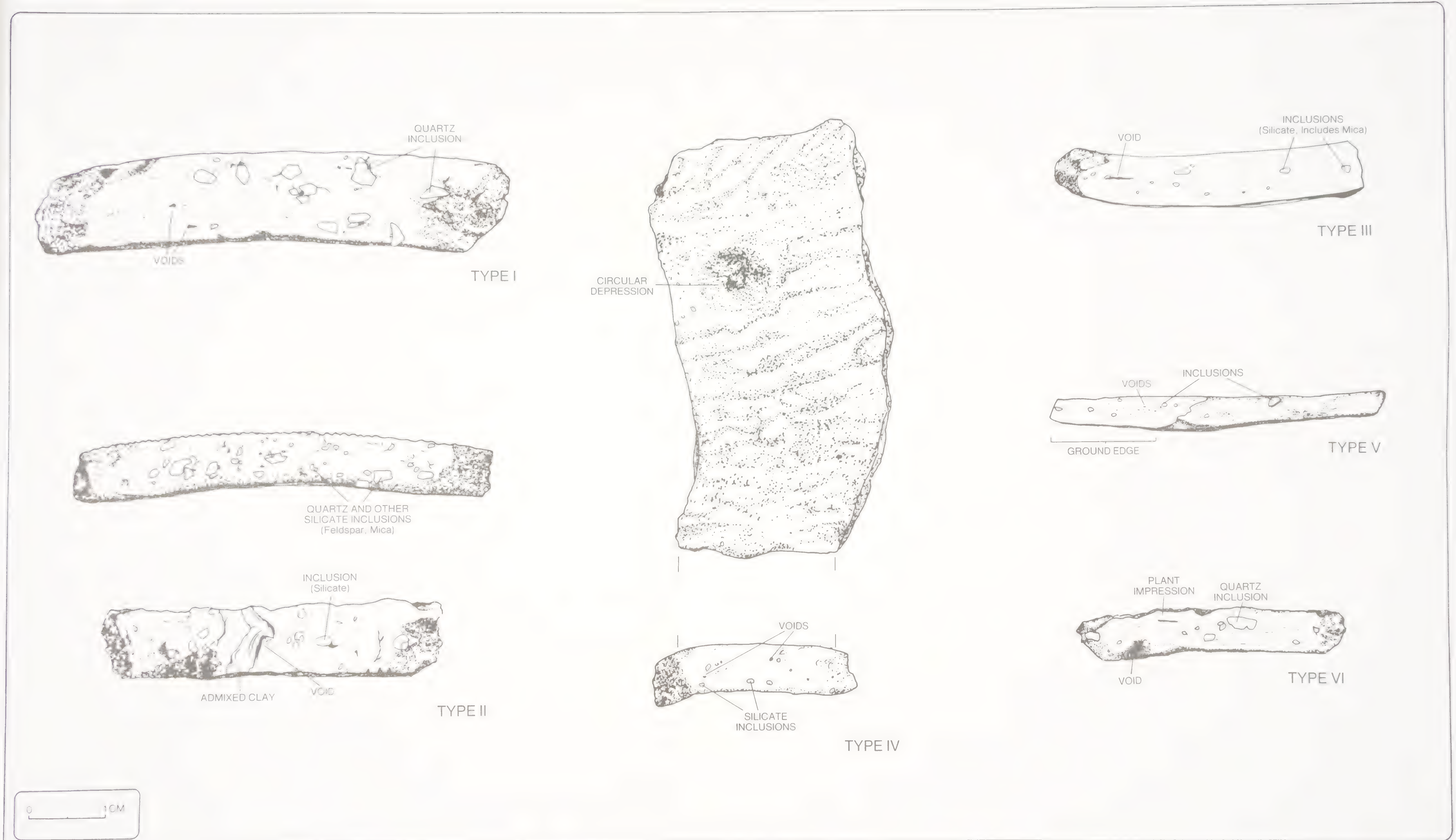

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FIGURE 10.1
TECHNOLOGICAL CERAMIC TYPES

medium orifice diameter, 22-30 cm
Munsell 7.5YR
Moh's knifeblade hardness
medium porosity
poor clay mixture
definite irregular fracture
feldspar inclusions, medium size/frequent amount
medium sherd thickness, 8-9 mm
medium vessel curvature, 32-38 cm

(2) medium exterior cord marking
Munsell 10YR
medium exterior treatment depth
plain, smoothed interior
smoothing over exterior treatment
Moh's fingernail hardness
well-mixed clay
even, sharp fracture
sand inclusions, small size/frequent amount

(3) large exterior cord marking
sand inclusions, small size/varying amounts

(4) small exterior net impressions
small/medium sherd curvature, 16-20 cm
oxidized interior
low porosity
crumbly fracture
feldspar inclusions, small and medium size/abundant amount

(5) medium net impressions
medium exterior treatment depth
exterior smoothing over treatment
thin sherds, 5-6 mm
Moh's fingernail hardness
well-mixed clay
even, sharp fracture
plain, smoothed interiors
Munsell 10YR

(6) small/medium roughened exterior
thick sherds, 10-17 mm

(7) small fabric exterior
shallow exterior treatment
smoothing over exterior treatment
plain, smoothed interior
Munsell 10YR
Moh's fingernail hardness
well-mixed clay
even, sharp fracture
sand inclusions, small size/frequent amount

(8) medium fabric exterior
deep exterior treatment
medium fabric interior
medium-deep interior treatment
plain, floated interior
Munsell 7.5YR
Moh's knifeblade hardness
poor clay mixture
medium sherd thickness, 8-9, 10 mm
definite irregular fracture
sand inclusions, medium size/frequent amount

(9) incised exterior
punctate exterior

(10) simple stamped exterior
brushed interior
quartz inclusions, medium size/frequent amount

(11) tooled exterior
tooled interior

(12) medium exterior treatment depth
sand inclusions, medium size/represented amount
feldspar inclusions, small size/frequent amount

(13) large sherd curvature, 〉40 cm
medium/large sherd area, 8-10 square cm
oxidized
reduced
Munsell 10YR
sand inclusions, medium size/represented amount
feldspar inclusions, small size/frequent amount

(14) medium sherd area, 6-7 square cm
Moh's fingernail hardness

(15) reduced core
Munsell gray

(16) low porosity
crumbly fracture
feldspar inclusions, small-medium size/abundant amount

These sixteen groups of variables are instructive from several perspectives. First, several of these groups demonstrate obvious agreement with variable patterning described in literature discussions; the degree of association between incising and punctations is one example. Second, predictable technological themes emerge, such as sherds of well-mixed clays exhibiting sharp, even fractures. Third, some of the groups suggest specific pottery type profiles; the first group of variables is very similar to descriptions of Yadkin vessels. Finally, some groups provide simple insight into aspects of prehistoric pottery manufacture; for example, exterior tooling is strongly associated with interior tooling. It should be emphasized that these statements of variable interaction or patterning do not completely or accurately convey atrribute covariation with respect to the collection of Haw River Reservoir ceramics. For this reason, an examination of multivariate attribute patterning followed these preliminary statistical results. This multivariate analysis incorporated the techniques of cluster analysis and multidimensional scaling.

Using the CLUSTAN suite of programs developed by Wishart (1978), cluster analysis of Haw River ceramics began with a controlled study of individual vessels recovered from site 31Ch8. As an initial step, sherds from Vessels III and IV, corresponding to Technological Type T-II, were clustered to test the sensitivity of clustering techniques to very similar vessels. As indicated by Figure 10.2 the analytic resolution was excellent. A second step of analysis extended these test conditions to three vessels, adding sherds from Vessel II (Technological Type T-III). Of particular interest were the effects of the relatively smaller sample of sherds from Vessel II, and the contrast of Vessel II attributes with those of Vessel III/Vessel IV. Figure 10.3 demonstrates the very satisfactory results of this investigation.

Encouraged by these results, the total sample of Haw River body sherds (n = 560) was analyzed by Ward's clustering algorithm, with a matrix of squared Euclidean distance measures of associaton among attributes as data input. The results of this analysis are presented in Figure 10.4. It should be noted that the graphic results displayed in Figures 10.2, 10.3 and 10.4 represent the cluster solutions produced by Ward's technique. Application of reallocation procedures to these data brought about more finely-tuned solutions;

however, the logic of dendrogram construction prevents comparable display of the reallocation results. In the following discussion, except as otherwise noted, statements of cluster definition reflect information obtained from reallocation methods. As an example of reallocation information gain, Cluster (4) in Figure 10.4 can be identified as Vessel IV. Before reallocation analysis, only 69 of 91 body sherds from Vessel IV were grouped in Cluster (4); after reallocation, 85 of the 91 sherds were grouped together.

In addition to Cluster (4), three other groupings of sherds are evident in Figure 10.4 Inspection of these four large clusters shows that while Vessel IV uniquely defines Cluster (4); Clusters (1), (2), and (3) do not equate clearly with specific vessels. These results indicated that further analysis was required in order to more accurately delineate individual vessel technology. Two different sets of information suggested specific analytic directions, namely, investigation of the 10-cluster solution level. First, reallocation procedures applied to a series of successive cluster solution levels, say, from 16 groups to 15 groups to 14 groups, etc., demonstrated a relative degree of membership stability for 10 clusters. Further, sherd membership in 10 clusters appeared to most accurately reflect individual vessels. Second, visual inspection of Figure 10.4 suggested study of the 10 cluster solution. Cluster (1) is composed of four subgroups; Cluster (2) is composed of Vessel III and another discrete group of sherds, and the large Cluster (3) contains three subgroups which correspond inexactly to the three Vessels I, II, and V. The tenth group is Cluster (4), representing Vessel IV.

The information contained in the respective groups of the 10-cluster solution can be studied from two perspectives, (1) sherd membership and (2) variable profiles. A summary of sherd membership in the 10 clusters (denoted A – J) is presented in Table 10.1.

Table 10.1
Vessel Membership in 10 Clusters

Cluster	Size	Vessel
A	n = 59	—
B	n = 43	—
C	n = 47	Vessel II, 14 of 36 body sherds
D	n = 50	—
E	n = 77	Sherds from lower levels of 31Ch8 Block B, Excavation Unit 3
F	n = 49	Vessel II, 15 of 36 body sherds
G	n = 74	Vessel III, 67 of 76 body sherds
H	n = 50	Vessel I, 11 of 11 body sherds
I	n = 87	Vessel IV, 85 of 91 body sherds
J	n = 24	Vessel V, 18 of 19 body sherds

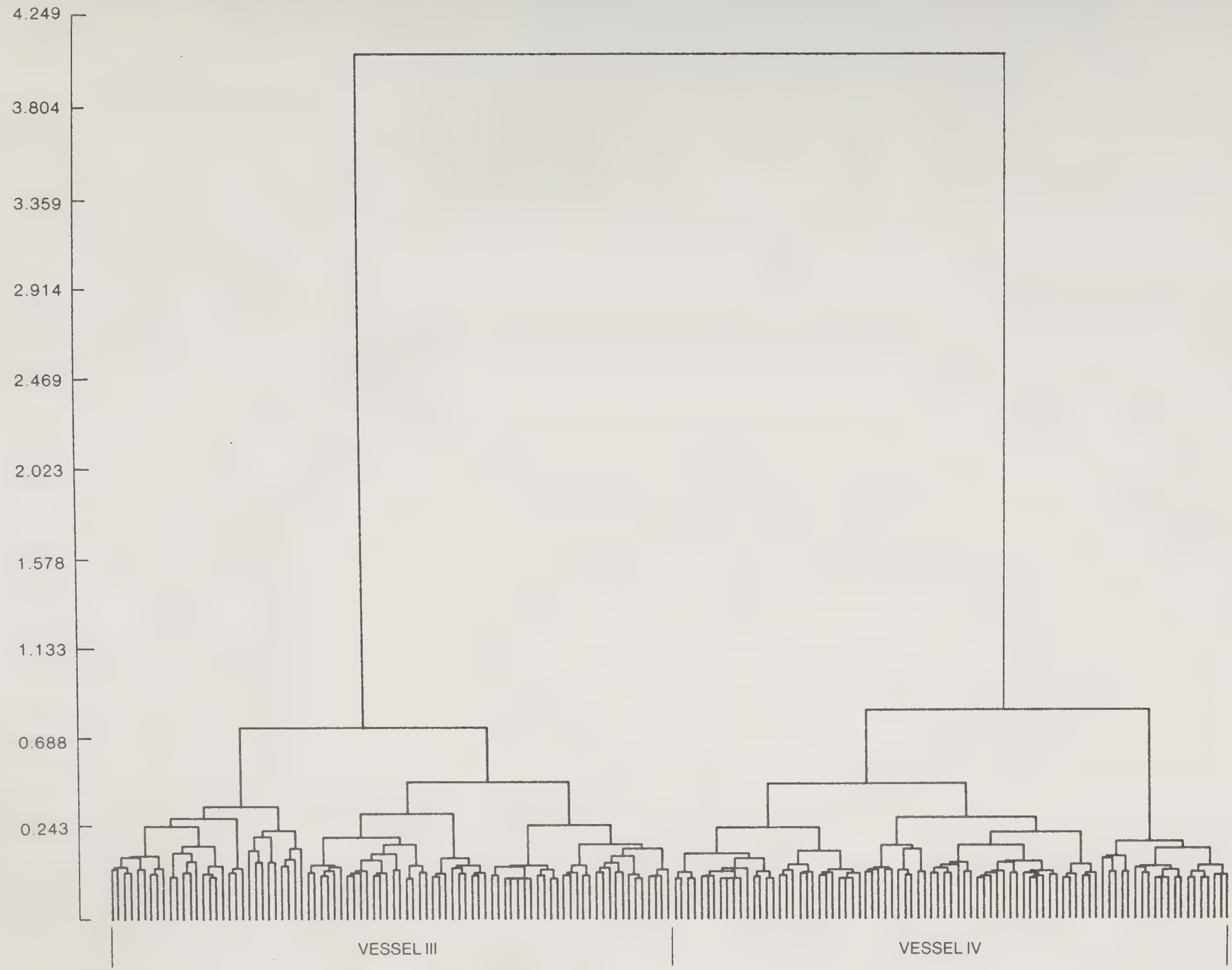

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FIGURE 10.2
CLUSTER REPRESENTATION OF
VESSELS III AND IV

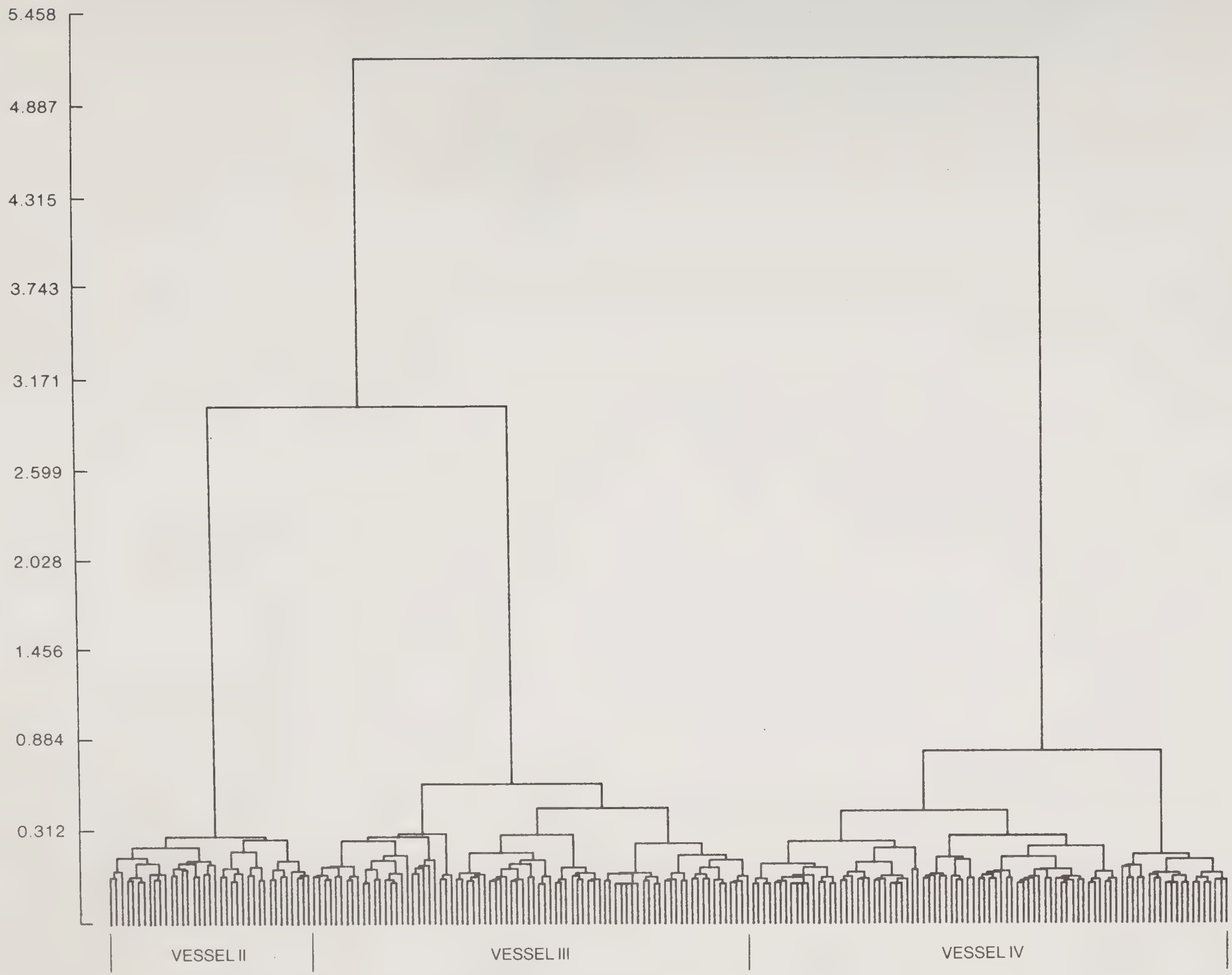

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FIGURE 10.3
CLUSTER REPRESENTATIONS OF
VESSELS II, III AND IV

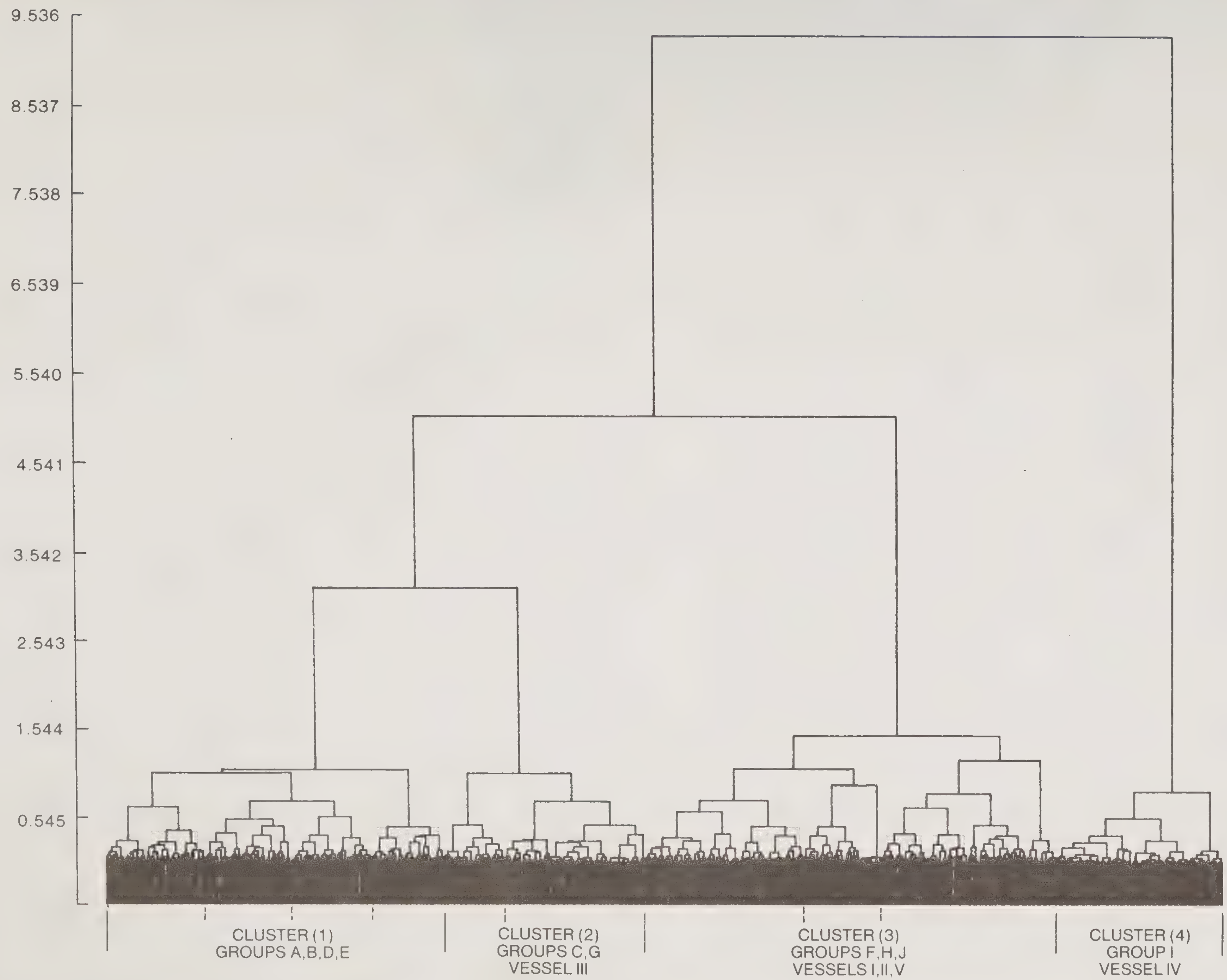

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FIGURE 10.4
CLUSTER GROUPINGS OF
HAW RIVER BODY SHERDS

Cluster E is of particular interest. Contained exclusively in Cluster E are sherds from the lower levels of Block B, Excavation Unit 3, at site 31Ch8. Occurring in levels 13-15 of Block B were ceramics assigned to Technological Type T-VI; T-VI sherds have been described as sandy and crumbly (see above). Significantly, these sherds occur in stratigraphic context with Late Archaic projectile points and other, "transitional," point forms (see discussion in Chapter 9).

Variable profiles describing trait patterning also provide insight into the 10 analytic clusters. The percentage occurrence of the 119 binary variables for each of the 10 clusters is shown in Table 10.2.

By studying these lists of traits, it is possible to further identify the character of the 10 sherd groupings. Cluster A, for example, is characterized by variables that indicate an early ware, intermediate in technological attributes between the early Cluster E (T-VI) sherds and Badin (T-III) ceramics. Cluster B, on the other hand, corresponds more directly with Badin ceramic technology. Cluster C, although known to contain sherds from Vessel II (T-III), resembles later proto-historic wares such as Hillsboro in overall complexion. Cluster F, which also contains sherds from Vessel II, predictably correlates with Technological Type II. Cluster D may be considered representative of Badin/Yadkin ceramic themes. The variables defining Cluster H indicate proto-historic ceramic patterns similar to those described by Technological Type V. Finally, the variable profile of Cluster J may be identified as that of Vessel V.

The general success of this cluster analysis is tempered by several errors of classification. The appearance of Vessel II sherds in both Cluster C and F is one example. Examination of Vessel II suggests that the probable causes of this grouping problem were the coding of "fracture quality" and "presence of feldspar inclusions." Fracture quality had been coded "even, sharp" whereas the category "definite, irregular" is perhaps more appropriate. Many of the sand inclusions present in Vessel II are feldspar; the structure of inclusion categories prevents adequate data coding in this situation. However, it may be noted that the problems of Vessel II misclassification are reminiscent of the Badin/Dan River assignment problems encountered by Coe (1964:29).

A second error of classification concerns a small group of late proto-historic and historic sherds which have punctation and incising. Six of these sherds were placed in Cluster D which describes Early Woodland ceramics. The misclassification is apparently a function of sherd size. It can be argued that the small incised/punctated sherds represent vessel neck sherds which fractured into small pieces because of the structural stress associated with neck construction.

A third source of error affecting the integrity of the variable profile information is the measure of hardness. The hardness measures employed in this analysis were perhaps the least definitive among the coded ceramic traits. Hardness information should, therefore, be regarded with caution, and the caveats discussed above about ceramic "hardness" should be re-emphasized.

Table 10.2
Binary Variable Profiles for 10 Clusters

Binary Variable

ID	A	B	C	D	E	F	G	H	I	J
1.	18.6	34.9	6.4	16.0	6.5	4.1	94.6	12.0	0.0	0.0
2.	8.5	32.6	66.0	20.0	9.1	67.3	2.7	18.0	0.0	4.2
3.	0.0	0.0	6.4	4.0	0.0	22.4	0.0	2.0	0.0	0.0
4.	5.1	0.0	0.0	0.0	2.6	0.0	0.0	2.0	0.0	0.0
5.	33.9	14.0	2.1	14.0	15.6	2.0	0.0	30.0	0.0	0.0
6.	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
7.	3.4	4.7	0.0	0.0	10.4	0.0	0.0	0.0	0.0	0.0
8.	8.5	0.0	2.1	4.0	7.8	2.0	0.0	6.0	0.0	4.2
9.	6.8	2.3	2.1	16.0	10.4	0.0	0.0	6.0	1.1	4.2
10.	8.5	2.3	0.0	16.0	14.3	0.0	2.7	6.0	98.9	0.0
11.	1.7	0.0	0.0	6.0	1.3	0.0	0.0	2.0	0.0	0.0
12.	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.7
13.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
14.	0.0	0.0	0.0	0.0	3.9	0.0	0.0	0.0	0.0	0.0
15.	0.0	0.0	0.0	0.0	3.9	0.0	0.0	6.0	1.1	8.3
16.	0.0	0.0	0.0	4.0	1.3	0.0	0.0	0.0	0.0	0.0
17.	1.7	7.0	8.5	0.0	14.3	0.0	0.0	12.0	0.0	4.2
18.	0.0	0.0	0.0	4.0	0.0	0.0	0.0	0.0	0.0	0.0
19.	5.1	0.0	4.3	14.0	40.3	0.0	1.4	16.0	0.0	45.8
20.	84.7	90.7	78.7	44.0	29.9	0.0	10.8	60.0	0.0	50.0
21.	8.5	0.0	6.4	38.0	10.4	100.0	87.8	12.0	100.0	0.0
22.	55.9	65.1	66.0	40.0	79.2	18.4	2.7	64.0	2.3	95.8
23.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
24.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
25.	3.4	0.0	0.0	2.0	0.0	0.0	0.0	2.0	94.3	0.0
26.	1.7	4.7	0.0	2.0	1.3	0.0	0.0	6.0	0.0	0.0
27.	0.0	0.0	0.0	4.0	1.3	0.0	0.0	0.0	93.1	0.0
28.	10.2	0.0	17.0	2.0	5.2	6.1	0.0	0.0	0.0	87.5
29.	1.7	0.0	0.0	8.0	0.0	0.0	0.0	4.0	0.0	0.0
30.	84.7	95.3	83.0	76.0	90.9	93.9	100.0	88.0	4.6	12.5
31.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
32.	5.1	0.0	8.5	4.0	0.0	0.0	1.4	0.0	0.0	37.5
33.	1.7	0.0	4.3	4.0	5.2	2.0	0.0	0.0	20.7	29.2

ID	A	B	C	D	E	F	G	H	I	J
34.	3.4	0.0	0.0	4.0	0.0	0.0	0.0	6.0	73.6	16.7
35.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
36.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
37.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
38.	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.0
39.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
40.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
41.	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.0
42.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
43.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
44.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
45.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
46.	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.0
47.	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.0
48.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
49.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
50.	0.0	7.0	0.0	6.0	1.3	0.0	0.0	28.0	0.0	0.0
51.	5.1	46.5	6.4	18.0	11.7	22.4	0.0	18.0	1.1	4.2
52.	47.5	32.6	8.30	44.0	45.5	59.2	94.6	50.0	56.3	87.5
53.	28.8	4.7	8.5	14.0	16.9	16.3	5.4	4.0	39.1	8.3
54.	18.6	9.3	2.1	18.0	24.7	0.0	0.0	0.0	3.4	0.0
55.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
56.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
57.	0.0	0.0	0.0	0.0	0.0	0.0	4.1	0.0	0.0	0.0
58.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
59.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
60.	1.7	0.0	0.0	8.0	3.9	4.1	0.0	4.0	0.0	0.0
61.	27.1	27.9	6.4	16.0	27.3	20.4	8.1	36.0	16.1	0.0
62.	16.9	46.5	44.7	28.0	28.6	34.7	21.6	40.0	33.3	50.0
63.	18.6	4.7	27.7	8.0	9.1	14.3	40.5	8.0	24.1	20.8
64.	8.5	2.3	14.9	10.0	10.4	18.4	24.3	4.0	11.5	8.3
65.	1.7	0.0	0.0	2.0	0.0	0.0	8.1	0.0	4.6	0.0
66.	57.6	81.4	14.9	90.0	55.8	46.9	45.9	64.0	50.6	54.2
67.	33.9	7.0	78.7	6.0	37.7	34.7	25.7	24.0	24.1	29.2
68.	6.8	9.3	6.4	2.0	6.5	18.4	18.9	10.0	10.3	16.7
69.	0.0	2.3	0.0	0.0	0.0	0.0	1.4	2.0	10.3	0.0
70.	23.7	7.0	12.8	22.0	20.8	36.7	28.4	54.0	35.6	41.7
71.	13.6	44.2	76.6	28.0	36.4	42.9	28.4	14.0	48.3	33.3
72.	1.7	4.7	2.1	6.0	5.2	6.1	12.2	2.0	0.0	4.2

ID	A	B	C	D	E	F	G	H	I	J
73.	52.5	39.5	6.4	38.0	26.0	8.2	31.1	28.0	13.8	16.7
74.	5.1	2.3	0.0	4.0	7.8	4.1	0.0	0.0	1.1	0.0
75.	3.4	2.3	2.1	2.0	3.9	2.0	0.0	2.0	1.1	4.2
76.	5.1	4.7	2.1	6.0	10.4	4.1	0.0	0.0	0.0	4.2
77.	1.7	67.4	63.8	52.0	76.6	71.4	12.2	4.0	1.1	62.5
78.	3.4	0.0	0.0	12.0	1.3	0.0	6.8	6.0	3.4	8.3
79.	89.8	27.9	34.0	26.0	11.7	20.4	81.1	88.0	94.3	25.0
80.	96.6	72.1	93.6	2.0	97.4	85.7	28.4	62.0	3.4	20.8
81.	3.4	27.9	6.4	98.0	2.6	14.3	71.6	38.0	96.6	79.2
82.	1.7	4.7	4.3	4.0	10.4	4.1	0.0	0.0	0.0	4.2
83.	84.7	86.0	80.9	70.0	74.0	83.7	94.6	44.0	98.9	83.3
84.	13.6	9.3	14.9	26.0	15.6	12.2	5.4	56.0	1.1	12.5
85.	3.4	90.7	93.6	12.0	1.3	77.6	1.4	100.0	0.0	87.5
86.	96.6	9.3	6.4	88.0	98.7	22.4	98.6	0.0	100.0	12.5
87.	5.1	16.3	74.5	6.0	10.4	53.1	2.7	88.0	3.4	8.3
88.	69.5	81.4	23.4	90.0	57.1	46.9	97.3	12.0	96.6	87.5
89.	25.4	2.3	2.1	4.0	32.5	0.0	0.0	0.0	0.0	0.0
90.	0.0	2.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
91.	0.0	2.3	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
92.	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0
93.	1.7	0.0	0.0	2.0	0.0	0.0	1.4	2.0	0.0	4.2
94.	11.9	2.3	2.1	26.0	1.3	0.0	0.0	8.0	0.0	79.2
95.	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0	0.0	0.0
96.	0.0	0.0	4.3	0.0	0.0	2.0	1.4	0.0	0.0	4.2
97.	0.0	0.0	6.4	0.0	1.3	2.0	0.0	8.0	0.0	0.0
98.	3.4	18.6	53.2	2.0	3.9	36.7	0.0	50.0	0.0	4.2
99.	0.0	4.7	8.5	2.0	1.3	6.1	0.0	4.0	0.0	0.0
100.	3.4	2.3	0.0	4.0	0.0	6.1	28.4	0.0	16.1	0.0
101.	10.2	30.2	12.8	14.0	3.9	42.9	4.1	4.0	35.6	0.0
102.	6.8	2.3	2.1	8.0	7.8	0.0	0.0	0.0	0.0	4.2
103.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0
104.	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
105.	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0
106.	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0	0.0	0.0
107.	6.8	18.6	4.3	6.0	2.6	4.1	24.3	10.0	3.4	0.0
108.	20.3	7.0	2.1	2.0	11.7	0.0	0.0	2.0	0.0	0.0
109.	0.0	0.0	0.0	0.0	1.3	2.0	0.0	2.0	2.3	0.0
110.	13.6	7.0	0.0	20.0	15.6	6.1	70.3	0.0	92.0	0.0
111.	20.3	0.0	0.0	10.0	45.5	0.0	4.1	0.0	0.0	4.2

ID	A	B	C	D	E	F	G	H	I	J
112.	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
113.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	0.0
114.	0.0	0.0	0.0	0.0	1.3	0.0	0.0	0.0	0.0	0.0
115.	3.4	2.3	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0
116.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
117.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	0.0	0.0
118.	0.0	0.0	2.1	0.0	0.0	4.1	2.7	0.0	0.0	0.0
119.	1.7	2.3	4.3	0.0	0.0	0.0	0.0	8.0	0.0	0.0

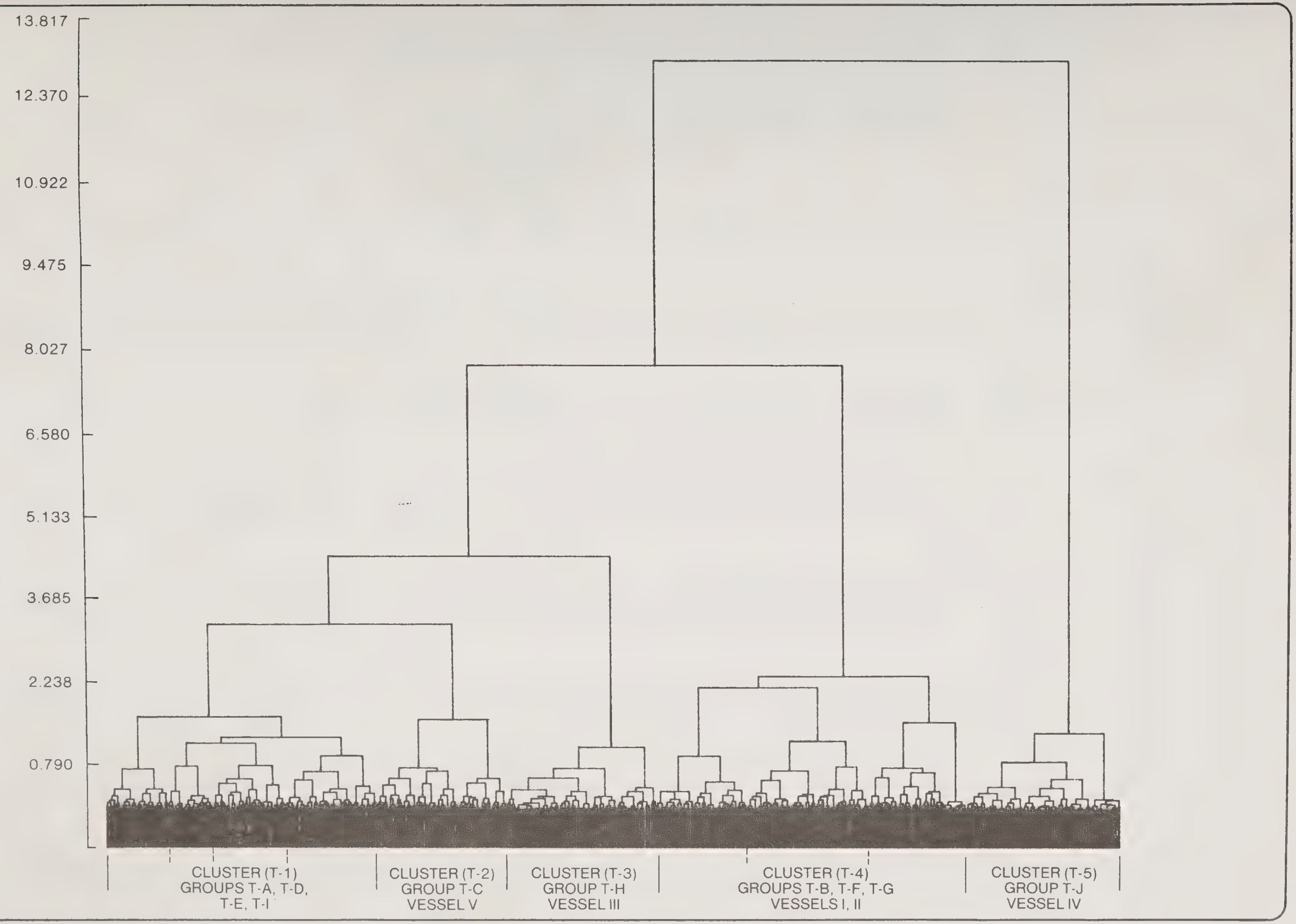
In response to the problems observed in this cluster analysis classification, a second cluster analysis was undertaken. This second classification proceeded in exactly the same manner as described above, but differed with respect to the variable traits processed by the clustering algorithms. Only sixty-five (65) binary variables were used in the second cluster analysis, which was termed the technological cluster analysis. These 65 variables were selected on the basis of their technological content; stylistic information, for example, was minimized. The cluster dendrogram produced by this analysis is presented in Figure 10.5. Preliminary inspection of this classification array suggested further study of, again, the 10-cluster solution. Table 10.3 shows vessel membership in the 10 technological clusters. (NOTE: Cluster designations A, B, etc., are not constant for the two cluster analyses.)

Table 10.3
Vessel membership in 10 Technological Clusters

Cluster	Size	Vessel
T-A	n = 67	—
T-B	n = 58	Vessel II, 26 of 36 body sherds
T-C	n = 38	Vessel V, 16 of 19 body sherds
T-D	n = 48	—
T-E	n = 56	Sherds from lower levels of Block B, Excavation Unit 3, 31Ch8
T-F	n = 49	Vessel I, 11 of 11 body sherds
T-G	n = 50	—
T-H	n = 65	Vessel III, 59 of 76 body sherds
T-I	n = 43	—
T-J	n = 86	Vessel IV, 83 of 91 body sherds

Table 10.4 presents the variable profiles characterizing each technological cluster group (denoted T-A, T-B, . . ., T-J). These data may be interpreted as follows. The variables in Cluster T-A suggest Early Woodland ceramic technology similar to both T-VI and T-III categories. Cluster T-B variables more narrowly correspond to T-III (Badin) characteristics; Vessel II sherds are contained in Cluster T-B. Attribute information for Cluster T-C compares favorably with descriptions of Technological Type T-I or Uwharrie sherds. Cluster T-D parallels the "all-variable" Cluster D and represents Badin/Yadkin ceramic themes. Cluster T-E matches the early Technological Type VI sherds found in the lower levels of Block B, 3lCh8. The variable profile of Cluster T-F closely resembles that of T-V/Vessel I. Late, proto-historic ceramics, similar to Technological Type T-IV, are described by Cluster T-G. Clusters T-H and T-J are indicative of general Yadkin pottery, such as Vessel III and Vessel IV, respectively. The traits expressed by sherds in Cluster T-I approximate those given for Technological Type II.

Comparison of the "all-variable" and "technological variable" cluster analyses is facilitated by reference to Table 10.5. The cluster groups in Table 10.5 are arranged in rough chronological order.



DATA RECOVERY AT SITES 31CH29 & 31CH8
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FIGURE 10.5
CLUSTER GROUPINGS OF
HAW RIVER BODY SHERDS
TECHNOLOGICAL VARIABLES

Table 10.4
Binary Technological Variable Profiles for 10 Clusters

Binary Variable

ID	A	B	C	D	E	F	G	H	I	J
1.	23.9	1.7	2.6	20.8	14.3	12.2	26.0	93.8	9.3	0.0
2.	10.4	72.4	21.1	18.7	5.4	16.3	40.0	1.5	32.6	0.0
4.	4.5	0.0	0.0	0.0	1.8	2.0	0.0	0.0	2.3	0.0
5.	28.4	1.7	2.6	10.4	12.5	32.7	12.0	0.0	16.3	0.0
11.	0.0	0.0	7.9	0.0	3.6	2.0	0.0	0.0	0.0	0.0
17.	1.5	5.2	2.6	0.0	12.5	12.2	6.0	0.0	11.6	0.0
19.	14.9	3.4	18.4	16.7	26.8	16.3	4.0	3.1	20.9	0.0
20.	62.7	55.2	60.5	43.7	42.9	55.1	58.0	13.8	30.2	1.2
24.	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	1.2
25.	3.0	0.0	0.0	4.2	0.0	2.0	0.0	0.0	0.0	94.2
27.	0.0	0.0	0.0	4.2	0.0	0.0	0.0	0.0	2.3	94.2
30.	88.1	86.2	47.4	77.1	92.9	89.8	90.0	100.0	86.0	2.3
33.	0.0	3.4	15.8	8.3	7.1	0.0	0.0	0.0	4.7	19.8
34.	3.0	0.0	10.5	2.1	0.0	6.1	0.0	0.0	0.0	75.6
50.	0.0	0.0	5.3	2.1	0.0	28.6	6.0	0.0	2.3	0.0
51.	6.0	1.7	5.3	14.6	21.4	20.4	50.0	0.0	9.3	1.2
52.	50.7	82.8	71.1	45.8	32.1	46.9	32.0	98.5	72.1	57.0
53.	23.9	15.5	7.9	20.8	17.9	4.1	6.0	1.5	14.0	38.4
54.	19.4	0.0	10.5	16.7	28.6	0.0	4.0	0.0	2.3	3.5
60.	1.5	1.7	0.0	8.3	3.6	2.0	4.0	0.0	2.3	0.0
61.	29.9	6.9	13.2	12.5	26.8	36.7	30.0	6.2	16.3	16.3
62.	22.4	43.1	44.7	35.4	21.4	38.0	36.0	18.5	41.9	32.6
63.	14.9	22.4	15.8	8.3	7.1	10.2	6.0	44.6	20.9	24.4
65.	3.0	0.0	2.6	2.1	0.0	0.0	0.0	6.2	0.0	4.7
66.	56.7	20.7	47.4	91.7	92.9	69.4	84.0	41.5	0.0	50.0
67.	31.3	62.1	34.2	6.2	0.0	18.4	12.0	29.2	93.0	24.4
68.	9.0	17.2	15.8	0.0	7.1	10.2	2.0	21.5	7.0	10.5
69.	0.0	0.0	0.0	0.0	0.0	2.0	2.0	1.5	0.0	10.5
70.	25.4	13.8	36.8	22.9	10.7	57.1	16.0	32.3	32.6	34.9
71.	13.4	60.3	21.1	31.2	37.5	14.3	58.0	29.2	44.2	48.8
72.	4.5	6.9	2.6	8.3	7.1	2.0	0.0	12.3	0.0	0.0
74.	7.5	1.7	0.0	2.1	8.9	0.0	2.0	0.0	2.3	1.2
75.	3.0	3.4	2.6	2.1	1.8	2.0	2.0	0.0	4.7	1.2

ID	A	B	C	D	E	F	G	H	I	J
77.	0.0	56.9	57.9	52.1	75.0	4.1	76.0	7.7	90.7	1.2
78.	0.0	0.0	7.9	10.4	7.1	6.1	0.0	7.7	0.0	2.3
79.	100.0	41.4	34.2	29.2	0.0	85.7	14.0	83.1	4.7	95.3
80.	100.0	94.8	7.9	0.0	100.0	63.3	88.0	18.5	90.7	3.5
81.	0.0	5.2	92.1	100.0	0.0	36.7	12.0	81.5	9.3	96.5
82.	1.5	1.7	5.3	4.2	7.1	0.0	6.0	0.0	11.6	0.0
83.	79.1	86.2	76.3	77.1	82.1	44.9	86.0	96.9	65.1	98.8
84.	19.4	12.1	18.4	18.7	10.7	55.1	8.0	3.1	23.3	1.2
85.	3.0	100.0	100.0	0.0	0.0	100.0	100.0	1.5	9.3	0.0
86.	97.0	0.0	0.0	100.0	100.0	0.0	0.0	98.5	90.7	100.0
87.	7.5	74.1	7.9	6.2	8.9	87.8	36.0	1.5	20.9	3.5
88.	10.1	24.1	89.5	89.6	60.7	12.2	62.0	98.5	60.5	96.5
89.	22.4	1.7	0.0	4.2	30.4	0.0	2.0	0.0	18.6	0.0
90.	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
91.	0.0	0.0	0.0	2.1	0.0	0.0	2.0	0.0	0.0	0.0
92.	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0
94.	6.0	1.7	57.9	20.8	5.4	6.1	4.0	0.0	2.3	0.0
95.	0.0	0.0	0.0	2.1	0.0	0.0	0.0	0.0	0.0	0.0
96.	0.0	5.2	2.6	0.0	0.0	0.0	0.0	1.5	0.0	0.0
97.	0.0	6.9	2.6	0.0	0.0	6.1	0.0	0.0	2.3	0.0
98.	3.0	74.1	10.5	2.1	3.6	46.9	14.0	0.0	2.3	0.0
99.	0.0	5.2	0.0	2.1	1.8	6.1	8.0	0.0	2.3	0.0
100.	0.0	0.0	2.6	4.2	5.4	0.0	2.0	30.8	4.7	16.3
101.	1.0	1.7	13.2	12.5	5.4	6.1	48.0	3.1	20.9	36.0
102.	6.0	0.0	5.3	8.3	8.9	0.0	2.0	0.0	2.3	0.0
106.	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.3	0.0
107.	9.0	1.7	0.0	6.2	7.1	12.2	10.0	21.5	11.6	3.5
108.	17.9	0.0	2.6	2.1	16.1	2.0	2.0	0.0	4.7	0.0
110.	16.4	0.0	5.3	25.0	10.7	0.0	4.0	72.3	20.9	91.9
111.	26.9	0.0	0.0	10.4	33.9	0.0	2.0	6.2	20.9	0.0
112.	0.0	1.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
114.	0.0	0.0	0.0	0.0	1.8	0.0	0.0	0.0	0.0	0.0

Table 10.5
Comparison of Cluster Analyses Sherd Groups

All-variable Clusters	Technological-variable Clusters
E	T-E
A	T-A
B	T-B
F	T-I
D	T-D
G	T-H
I	T-J
J	T-C
H	T-F
C	T-G

The imperfect congruence between the two cluster analyses directs attention to several issues. First, the subset of 65 technological variables more successfully grouped sherds from Vessel II. On the other hand, Vessel III was not as clearly delineated in the technological clusters. Secondly, it should be noted that comparable classification results were achieved with a reduced variable set that minimized conventional stylistic surface treatment information. Several categories of aplastic inclusions were also eliminated from the technological analysis. The reduction in number of analytic attributes is important for the logistics of laboratory analysis. It appears that additional research can establish a small, finite set of highly discriminating variables which can be easily and correctly identified during laboratory study.

The application of robust MDS statistical algorithms to the data patterns established by cluster analysis created a display of the structural relationships among the cluster groups of Haw River sherds. In order to accommodate the different information contained in the "all-variable" and "technological variable" data sets, two MDS models were analyzed. The results of MDS are analogous to cluster analysis in that alternative solutions must be evaluated by the researcher. Evaluation of MDS results can be effectively reduced to critique of information distortion in the pattern of displayed data points. This distortion is measured by "stress," which reflects the "goodness of fit" between the original data-point relationships and those relationships as described by the successive configurations in lower dimensions. Kruskal (1964) refers to stress as a measure of "badness of fit." Stress can be expected to increase as the number of dimensions in which the data points are displayed decreases.

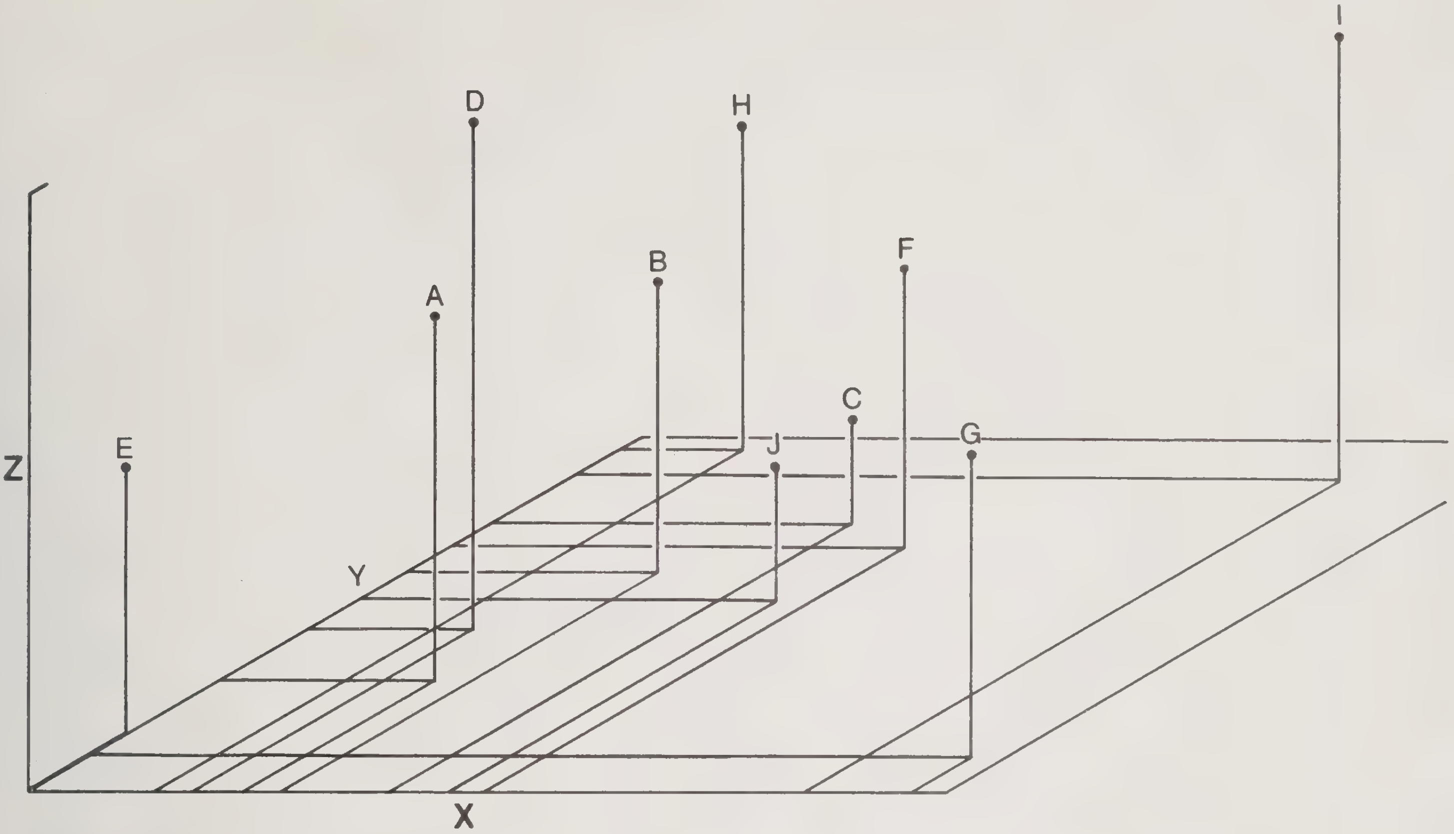
Inspection of stress coefficients from MDS analyses of Haw River cluster sherd-groups indicated that three dimensions were necessary to satisfactorily display data point relationships. The mappings of the 10-cluster sherd groups in three dimensions are shown in Figure 10.6 for the "all-variable" groups, and Figures 10.7 for the "technological variable" groups. The similarity between the two sets of variables is clear.

The MDS spatial models suggest several themes of Haw River ceramic technology. The first theme is represented by points E and T-E, which correspond to a pre-Badin technology (cf. Technological Type T-VI). The second theme may be considered Early Woodland in nature, and encompasses sherd-groups A, B, F, D and T-A, T-B, T-I, and T-D. A third ceramic theme can be clearly noted in points I, G and T-J, T-H. These points represent Vessels III and IV which were excavated from the same archeological feature (31Ch8/BlockC/Excavation Unit 7/Square 1/Levels 4-8/Feature 5). Data points J/T-C, H/T-F, and C/T-G each represent distinct late, proto-historic wares. Points J/T-C are perhaps best described as Uwharrie ceramics (cf. Technological Type T-I). The points H/T-F equate with sherds from Vessel I (cf. Technological Type T-V). The remaining sherd-group C/T-G is reminiscent of historic Hillsboro ceramics.

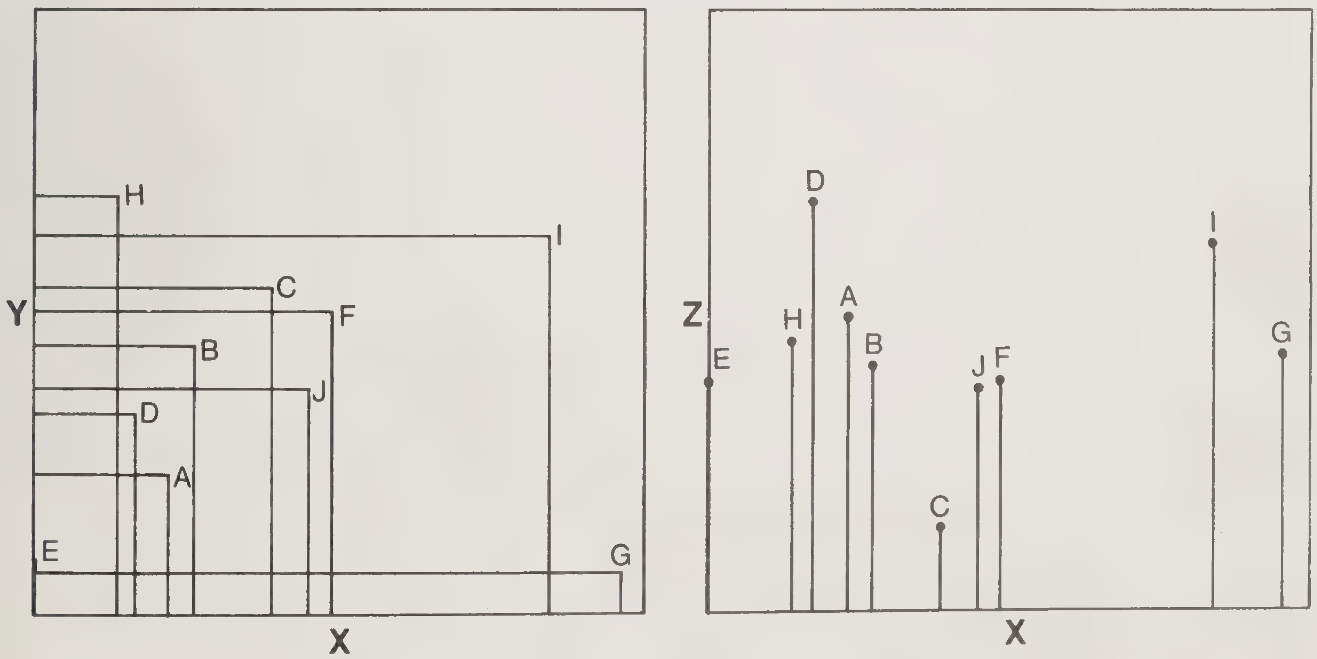
The information obtained from the multidimensional scaling analysis of the Haw River Reservoir pottery may be studied further. Of particular concern is an understanding of ceramic themes which determine the structural relationships exhibited in Figures 10.6 and 10.7. In other words, given the identification by cluster analysis of 10 sherd groups, the problem is to discover interpretable relationships among these groups. The identification of ceramic themes expressed by Jordan Reservoir sherd groups is discussed next.

The MDS structural relationships among the data points (sherd groups) has been determined by the information contained in the variable profile characteristic of each point or group. Definition of ceramic themes or dimensions, on the other hand, is established by reference to the data-point structure vis-a-vis the three axes of Figures 10.6 and 10.7. The adequacy of three axes for delineation of Jordan Reservoir "pottery space" has been discussed above. It follows that in order for the data-point co-ordinate information to accurately reflect the *relative* contribution of each sherd group to dimension definition, it is necessary to normalize the data-point co-ordinates shown in Figures 10.6 and 10.7. Table 10.6 presents, first, the MDS data-point (sherd group) co-ordinates for the "all variable" scaling maps shown in Figure 10.6, and second, the normalized MDS co-ordinates. Comparison of the co-ordinate measures for data-points (sherd groups) E and F convey these normalization issues clearly.

The normalized co-ordinate data given in Table 10.6 can be displayed by means of triangular co-ordinate graphs — see Figure 10.8. It is then a straightforward matter to determine respective axis labels, i.e., ceramic themes, by reference to the variable profiles of each data-point (sherd group). These ceramic themes are identified in Figure 10.9.



MULT-DIMENSIONAL SCALING MAP



C—CONTAINS PART OF VESSEL II

E—EARLY WARES FROM BLOCK B—LOWER LEVELS

F—CONTRAINS PART OF VESSEL II

G—VESSEL III

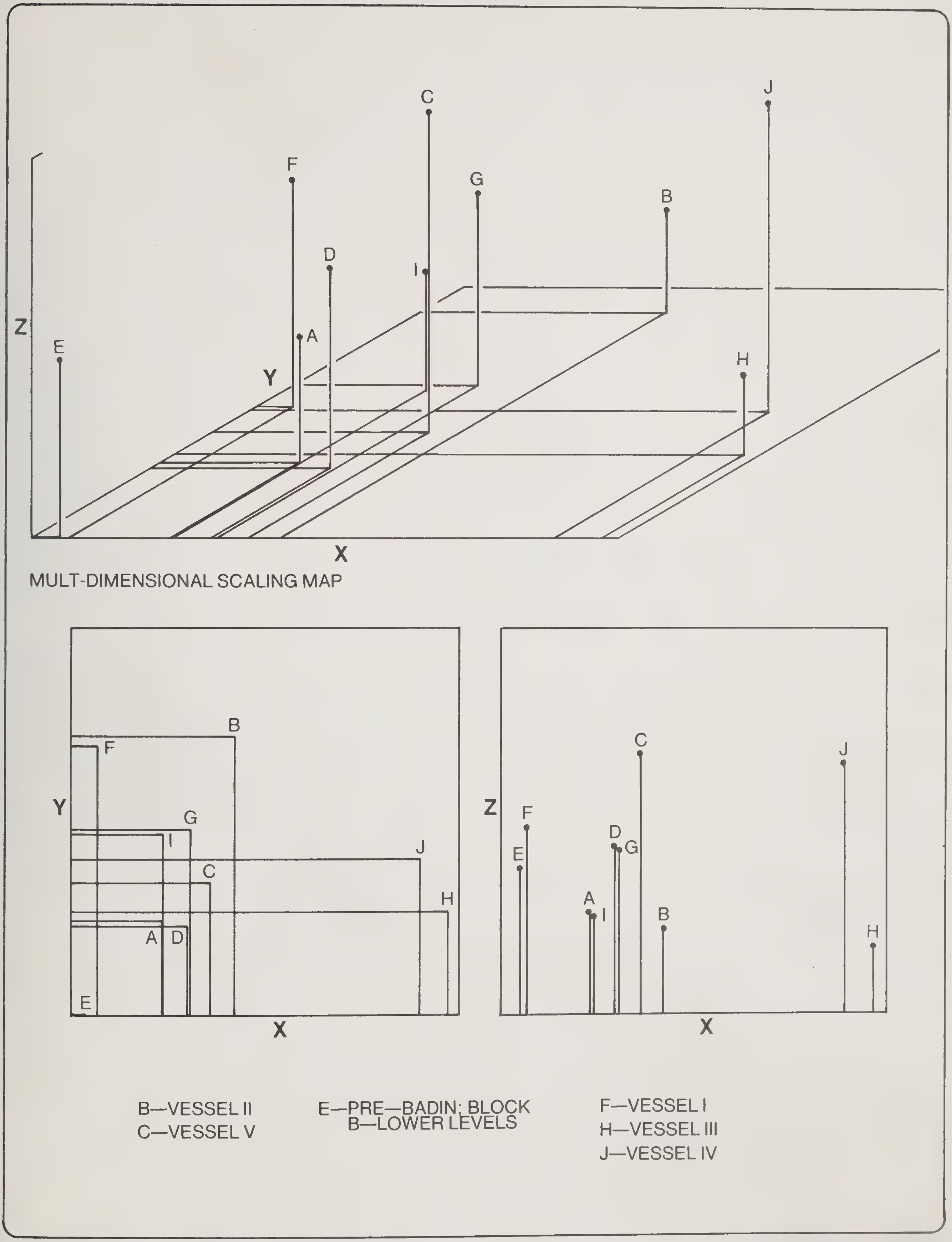
H—VESSEL I

I—VESSEL IV

J—VESSEL V

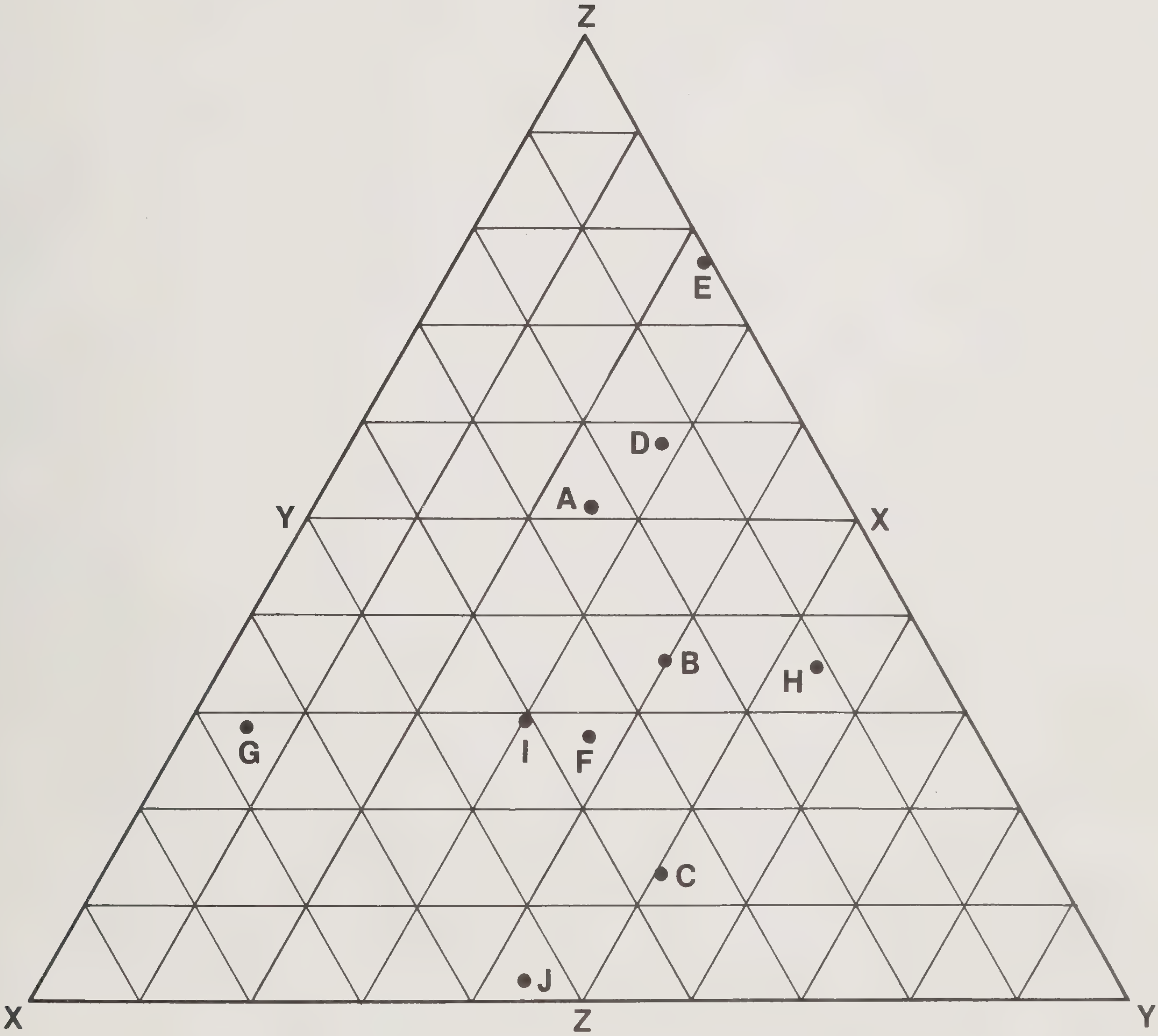
DATA RECOVERY AT SITES 31CH29 & 31CH8
B. EVERETT JORDAN DAM & LAKE
CHATHAM COUNTY, NORTH CAROLINA
COMMONWEALTH ASSOCIATES, INC.

FIGURE 10.6
SCALING MAPS — CLUSTER SHERD GROUPS
ALL BINARY VARIABLES



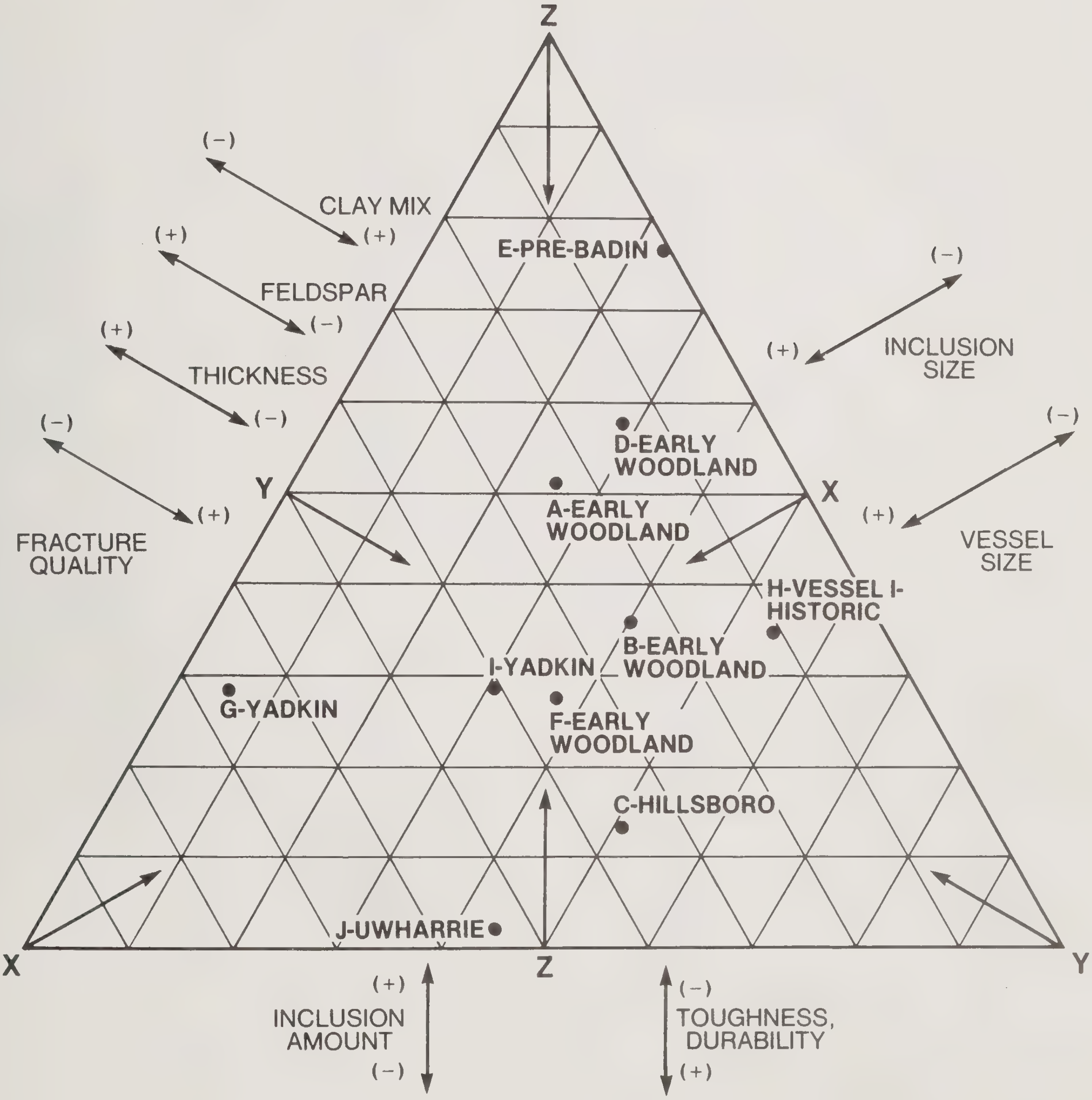
DATA RECOVERY AT SITES 31CH29 & 31CH8
B. EVERETT JORDAN DAM & LAKE
CHATHAM COUNTY, NORTH CAROLINA
COMMONWEALTH ASSOCIATES, INC

FIGURE 10.7
SCALING MAPS —
CLUSTER SHERD GROUPS
TECHNOLOGICAL BINARY VARIABLES



DATA RECOVERY AT SITES 31CH29 & 31CH8
B. EVERETT JORDAN DAM & LAKE
CHATHAM COUNTY, NORTH CAROLINA
COMMONWEALTH ASSOCIATES, INC.

FIGURE 10.8
TRIANGULAR PLOT OF
10 SHERD GROUPS
ALL VARIABLES



DATA RECOVERY AT SITES 31CH29 & 31CH8
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COMMONWEALTH ASSOCIATES, INC

FIGURE 10.9
CERAMIC THEMES OF
HAW RIVER POTTERY

Table 10.6
MDS and Normalized Data-point (Sherd Group) Co-ordinates

	X	Y	Z
MDS			
A	.568	.596	1.215
B	.681	1.126	1.005
C	.986	1.374	.367
D	.419	.830	1.703
E	.0	.281	.935
F	1.217	1.272	.949
G	2.421	.186	1.051
H	.347	1.733	1.111
I	2.116	1.575	1.520
J	1.146	.926	.045
Normalized			
A	.239	.251	.511
B	.242	.400	.357
C	.362	.504	.135
D	.142	.281	.577
E	.0	.231	.769
F	.354	.370	.276
G	.662	.051	.287
H	.109	.543	.348
I	.406	.302	.292
J	.541	.437	.021

By reference to Figure 10.9, it is possible to study the relationships among differing pottery "types" according to defined ceramic themes. The inflexible nature of quantitative data coding suggests that the proximities in Figure 10.9 are not absolute; however, these data remain rigorously defined.

The MDS normalization procedures were also applied to the co-ordinates of the "technological variable" scaling maps (Figure 10.7). Interestingly, only two or three ceramic themes could be established. This situation is a function of the information contained in the technological attribute set. Whereas the set of technological attributes more clearly established cluster sherd groupings, this attribute set failed to provide adequate information about the relationships among the sherd groups.

In order to further study the information content of the different attribute sets, six additional MDS maps were produced: (1) 16 cluster sherd groups, "all variable" attribute set; (2) 16 cluster sherd groups, "technological variable" set; (3) 10 cluster *rim* sherd groups, "all variable" set; (4) 10 cluster *rim* sherd groups, "technological variable" set; (5) 6 cluster *rim* sherd groups, "all variable" set; and (6) 6 cluster *rim* sherd groups, "technological variable" set. Technically, the 16 cluster sherd groups were analytically "too refined"; i.e., known vessels were broken into two or three groups on the basis of sherd area, sherd thickness, etc. The information content of the rim sherd groups, on the other hand, was compromised by small sample size. For these reasons, specific analytic details are not presented here. The important consequence of this exercise is that meaninful ceramic themes were consistently identified after MDS mapping and normalization of MDS co-ordinates. These results emphasize earlier suggestions that continued research should be able to establish limited sets of ceramic attributes which can convey extensive information.

CHAPTER 11

ORGANIZATIONAL VARIABILITY IN PIEDMONT HUNTER-GATHERER LITHIC ASSEMBLAGES

STATEMENT OF PROBLEM

The reasons for artifactual variability across geographic space and through time are central issues in archeological research. Classic debates between Francois Bordes and Lewis Binford brought the theoretical constructs of this issue into fine focus. Bordes perceived the causes of artifact variability to be linked to cognitive differences. Thus, the various types of Mousterian assemblages that he defined for southwestern France represented the residues of different tribes, although the assemblages basically differed from one another only in the proportions of tool types rather than in more distinctive stylistic ways. Binford challenged this notion, preferring to view the observed variability in Mousterian assemblages as a result of functional differentiation (Binford 1972, 1973 and Binford and Binford 1966, 1969). With a new paradigm, Binford suggested that relative tool frequencies on archeological sites vary in accordance with the kinds of activities performed at specific locations, rather than simple cognition. Although he succeeded in presenting plausible arguments explaining this variability in terms of a "systemic" paradigm, Binford could not demonstrate the unsuitability of the paradigm advanced by Bordes to explain these same patterns. Commenting on this problem several years later (Binford 1978a) concerning the systemic view of culture and the Mousterian faunal assemblage of Combe Grenal, Binford (1978a:11-12) stated:

> In spite of these obvious advantages, I still could not see how to demonstrate that the activities of use were inappropriate to a fabrication model [Bordes' paradigm] for the formation processes of the archaeological record. Such a situation had frequently been pointed out by my critics. It had been asserted that activities are also cultural — that is, the fabrication model of dynamics applies equally to activities of use as it does to the activity of tool production. To this assertion there is no appeal except to the empirical world. Do people behave this way? Do people conduct their ongoing activities in terms of invariant mental templates as to the appropriate strategies regardless of the setting in which they find themselves? Do members of a given cultural unit, equal participants in a tradition, fabricate tools for use in their activities in terms of a shared ideal as to what their assemblage should look like in terms of the relative frequencies of tools or other elements? Are the results of actually coping with the world isomorphic with the traditionally passed on ideas as to means for coping? Are the cultural means independent of the problems presented to a group for solution?

To obtain answers to such questions about the way the world is, one must investigate the relevant world. What is relevant here? Would seeking additional empirical experience through the excavation and subsequent analysis of additional archaeological facts provide the relevant experience? The answer must be no. The relevant experience is one where we can directly experience the character of the linkage between the archaeological by-products and behavior. At the same time we must be able to evaluate the behavior relative to the degree to which it is differentially responsive to situational variables, the degree to which individuals sharing a common tradition or body of common knowledge use this shared culture differentially in dealing with situational differences arising from the dynamics of their environment, and the character of the adaptive interaction between persons and their environment. It is necessary to experience directly the process of adaptation and in turn the archaeological products of this process. Relevance is achieved when we can examine variability in the archaeological products and hold culture a constant. In this situation, we could directly evaluate the utility of the fabrication model of behavior as the assumed link between the dynamics of behavior and the static facts remaining for us to observe.

Binford (1978a) advanced a major breakthrough in archeological research. He demonstrated that the operation of a single culture or adaptive system can produce inter-site variability in at least one kind of artifactual assemblage (faunal remains) that is directly attributable to differential use of an environment. We wish to explore a related but separate question from Binford's, which examined inter-assemblage variability in a single adaptive system. We want to examine similar factors which potentially conditioned tool assemblage variability in an archeological sequence thereby representing a succession of different adaptive systems within a single unit of geographic space. More specifically, we wish to consider the effects of post-glacial environmental change on hunter-gatherer adaptive systems in North Carolina as reflected in the properties of technological organization inherent in the lithic assemblages of the Haw River sites.

Unlike Binford, we are unable to observe first-hand the linkages "between the dynamics of behavior and the static facts remaining for us to observe" (Binford 1978a:12). The explanations we offer therefore can only be suggested solutions to theoretical problems. Even direct observation of phenomena, however, does not guarantee that the meaning we assign to events is "right." Notions concerning the manner in which the real world operates can only be discredited by conceptualizations which are judged by a community of scientists to be of greater utility in explaining the relationships between a set of relevant phenomena (see Kuhn 1964). Thus we present our views for critical appraisal.

For purposes of this discussion, we have chosen to explore Binford's systemic paradigm. By holding culture constant, as Binford did, we want to examine the alternate factors responsible for producing diachronic variability in artifact assemblages from a single area. Since we have assumed that the observed variability in the Haw River lithic assemblages is a consequence of adaptive change, thus it is most appropriate to examine this variability from a paleoecological perspective. This means that the physical environment plays a major role in such an explanation. As Pianka (1978:83) explains:

> Organisms are adapted to their environments in that, to survive and reproduce, they must meet their environment's conditions for existence. Adaptation can be defined as conformity between the organism and its environment. Plants and animals have adapted to their environments both genetically and by means of physiological, behavioral, and/or developmental flexibility. The former includes instinctive behavior and the latter learning. Adaptation has many dimensions in that most organisms must conform simultaneously to numerous different aspects of their environments. Thus an organism, to be adapted, must cope not only with various aspects of its physical environment, such as temperature and humidity conditions, but also with competitors, predators, and escape tactics of its prey. Conflicting demands of these various environmental components often require than an organism compromise in its adaptations to each.

Elements of technology in human systems represent a direct interface between the environment and adaptive strategies and therefore should constitute a basic unit of observation in measuring the "conformity" of which Pianka speaks. The obvious differences between the technologies of such diverse groups as the Central Eskimo and the Western Desert Aborigine present an example. The Central Eskimo possessed a very elaborate, diverse and specialized technological assemblage (Boas 1888). By contrast, the technology of the Western Desert Aborigine (see Gould 1971, 1980 and Hayden 1977, 1979) is simple and non-formalized. The great differences between these groups can be viewed as different adaptive organizations in response to "their environment's conditions for existence" (Pianka 1978:83). Although the assemblage differences we wish to discuss for the Holocene cultures of North Carolina are probably not as dramatic an example, significant changes in adaptive strategy took place during this time which we contend are reflected in lithic variability.

GENERAL ECOLOGICAL THEORY

The general body of literature concerning ecological theory provides a basis for developing a perspective on prehistoric adaptive change in North Carolina. This discussion is framed in terms of the contrastive responses of animals (including humans) to different environments. Terrestrial environments, in a very basic level, can be characterized as either immature or mature (see Margalef 1963, 1968 or E. P. Odum 1969). Immature environ-

ments represent the earlier stages of ecological succession or environments where climatological, edaphic or other factors prevent a forest climax as in prairies, tundra, savannah or deserts. Mature environments, as implied above, represent those ecosystems which contain forests.

E. P. Odum (1971:251) defines ecological succession in the following manner:

> Ecosystem development, or what is more often known as ecological succession, may be defined in terms of the following three parameters: (1) It is an orderly process of community development that involves changes in species structure and community processes with time; it is reasonably directional and, therefore, predictable. (2) It results from modification of the physical environment by the community; that is, succession is community-controlled even though the physical environment determines the pattern, the rate of change, and often sets limits as to how far development can go. (3) It culminates in a stabilized ecosystem in which maximum biomass (or high information content) and symbiotic function between organisms are maintained per unit of available energy flow. The whole sequence of communities that replaces one another in a given area is called a sere; the relatively transitory communities are variously called seral stages or developmental stages or pioneer stages, while the terminal stabilized system is known as the climax. Species replacement in the sere occurs because populations tend to modify the physical environment, making conditions favorable for other populations until an equilibrium between biotic and abiotic is achieved.

Succession can be further delineated in terms of primary and secondary processes (see Oosting 1956:240-242). Primary succession consists of the normal stages of succession for a particular ecosystem. Secondary succession, on the other hand, represents the interruption of normal community development by such factors as "fire, cultivation, lumbering, wind throw, or any similar disturbance of the principle species of an established community" (Oosting 1956:240). The initial pioneer communities which develop after such disturbances may or may not resemble the seres of primary succession, but the later stages will again approximate the climax community.

Ecological succession also occurs as a long-term process in response to global changes in the environment. The geological history of any given area on earth presents a record of environmental change which often evidences a succession of radically different ecosystems. At the largest temporal scale, these changes reflect evolutionary processes. During the Holocene, however, environmental change can be seen as operating below the level of evolution, yet changes which occurred in the post-Wisconsin glaciation environments of North Carolina are expected to exhibit a directional or "predictable" succession of adaptions and geographic distributional adjustments in response to a gradual climatic warming

trend. This is quite evident in the time-transgressive character of temperate forests during and following the Pleistocene (see Davis 1976). If lithic technologies reflect adjustments in human adaptive systems, then sequence variability in lithic assemblages should be expected to exhibit directional change with the appearance of a "progressive" evolutionary scheme. In our discussion it is important to note that selection in the prehistoric hunter-gatherer systems operates directly at the level of adaptation rather than evolution.

Mature and immature environments are distinguished by different strategies that animals will adopt to exploit these two contrasting types of environments. Margalef (1963, 1968) developed a useful synthetic predictive model relating biological succession to variability in ecological organization or structure based on the relative maturity of ecosystems. Succession is seen to exist along a spectrum ranging from simply organized systems such as the arctic tundra to the most complex systems such as tropical rain forests. In any single locality complexity can vary with the stages of primary and secondary succession.

The structure of ecological communities depends upon the character of energy exchanges. Food chains represent the various pathways of energy transfer within ecosystems and, taken together, the food chains of a particular ecosystem comprise its food web (see Pianka 1978:271-272 or E. P. Odum 1971:63).

The structure of the various linked trophic levels of a food chain is pyramidal with the greatest proportion of the energy within a community usually stored in the food producers (plants). Herbivores (or plant consumers) comprise the second level of the pyramid. Carnivores (animal consumers) of one type or another occupy the upper levels and are generally the least numerous because they feed on gradually decreasing energy sources. Pyramids are usually characterized according to three basic dimensions: numbers of individuals, biomass (amount of mass) and productivity.

Comparions of Immature and Mature Ecosystems

Given these basic definitions we can discuss contrasting structures of immature and mature ecosystems. Odum (1969:265) describes these differences in terms of a number of ecological attributes which are subsumed under a set of closely linked dimensions including community energetics, community structure, life history, nutrient cycling, selection pressure, and overall homeostasis. Generally, immature systems are simple and poorly organized while mature systems are diverse and well integrated and organized. Species diversity increases throughout the process of succession (Margalef 1968:30-31; E. P. Odum 1969:265, 1971:255), but the character of this diversity can vary depending on the niche breadths of a community and the relative abundances of species within a community (Pianka 1978:286-289).

An ecological "niche" is a difficult term to define because of its broad application, but for our purposes, it can be seen as comprising the factors which define the adaptation of a species. It includes the particular habitat within which a species functions, the trophic status of the species, the abiotic factors (i.e. climatic, chemical, etc.) which limit the geographic distribution of a species (Hutchinson's 1965, "fundamental niche") and the biotic factors (i.e. competition) which tend to limit niche breadth within an ecosystem (Hutchinson's, 1965, "realized niche").

Another component of species diversity is termed equability, which relates to the relative abundances of species within a community. In any ecosystem there are generally some species that are proportionately more abundant than others. Equability increases as the proportional differences between the abundances of species decreases. For example, two communities with the same number of species can show radical differences in equability. One community may be dominated by one or two species and the rest may be represented by very few individuals, while another community may contain a relatively even proportion of individuals per species. The first case describes a minimum or low equability situation while the second case describes maximum or high equability (E. P. Odum 1971:149). Species equability tends to increase with maturity. Aggregations of certain species are a common characteristic of immature systems, while a more even distribution of species should be found in mature systems.

Because of the different structural properties of mature and immature systems, the species that inhabit these communities must respond to different selective pressures (MacArthur and Wilson 1967). Immature systems are typified by quantity production and mature systems favor quality production or high maintenance in individuals. In MacArthur's and Wilson's terms, immature systems reflect selection strategies with maximized population increase, while mature systems reflect selection strategies wherein competitive ability in a saturated environment is maximized rather than production of more individuals. Thus, in immature systems energy investment is directed toward low maintenance of individuals and fast production of more individuals which ultimately results in small body size, rapid growth and short, simple life cycles. By contrast, mature systems favor high energy investments in individuals resulting in large body sizes and long, complex life cycles.

In summary, immature ecosystems have simple structures geared to quick production and low maintenance. Food chains are short and linear, limited primarily to the grazing chain and trophic levels are small in number. Detritus recycling by microorganisms is unimportant. Although primary production is relatively low, the greatest proportion of energy is channeled into new growth rather than to the maintenance of long-lived species. Selection pressure on populations favors increased reproductive rates. Life cycles of organisms under such conditions are short and simple which generally results in smaller body sizes. Niche spaces are broad and both components of species diversity, variety and equa-

bility, are low. As a consequence aggregations of certain species are common. Finally, immature systems are relatively unstable, controlled primarily by abiotic factors (i.e. climate) and populations are subject to dramatic demographic adjustments in response to this instability.

Mature systems by contrast are complex and geared toward competitive fitness. Energy flow is channeled into the maintenance of long-lived organisms and to the detritus food chain. Therefore, although primary productivity is high, very little of this production is invested in new growth. Trophic levels are numerous and food-chains are complex and weblike. The variety and equability components of species diversity are high and niche breadth is narrow. Mature systems are less importantly associated with climates, and abiotic factors have a more stable influence. Greater species diversity also works to stabilize mature systems by ameliorating population fluctuations. Thus, the demographic structure of mature systems is relatively stable. Organisms in such environments usually achieve large body sizes and long life cycles as selection pressures are geared toward the survival of individuals under conditions of intense competition or crowding.

Optimal Use of Patchy Environments

Pianka (1978:144) states that generally "habitats consist of a spatial-temporal mosaic of many different, often intergrading, elements, each with its own complement of organisms and other resources." These elements of a habitat are what ecologists refer to as patches. Patches, which have both a spatial and a temporal or seasonal dimension, have a profound effect upon the distributions, interactions and adaptations of organisms. Wiens (1976:83) explains that patches represent environmental discontinuities that contain adaptive significance for the organisms in question. As a consequence, it should be appreciated that patches can exist at almost any geographical scale, depending on the scale at which organisms are adapted.

On a broad scale ecosystems vary in their degree of "patchiness." Mature systems, because of their high species equability and variety components, are well-mixed in terms of resource distributions and are therefore fairly homogeneous or uniform. The species composition for any given space within the system does not differ appreciably from any other given space in the system. Immature systems, on the other hand, tend to exhibit uneven species distributions resulting in greater heterogeneity. In this case, discontinuities in the environment are distinctive and contain different proportions and/or compositions of resources.

The optimal resource selection strategy of an organism is a function of environmental structure and the overall size and morphology of the organism, and is also affected by decisions as to where to search, search time, decisions to pursue a resource once located, and pursuit time (see MacArthur 1972:59-62). MacArthur and Pianka (1966) originally cast

the relationship between resource structure and organism exploitative strategies in terms of a distinction between fine-grained and patchy environments. In a fine-grained environment (homogeneous resource distributions) organisms attempt to utilize resources in the proportion in which they occur. Patchy environments (heterogeneous) are referred to as coarse grained environments (see Pianka 1978:263). In this case, organisms adopt differential selective strategies of exploitation and "spend disproportionate amounts of time in different patches" (Pianka 1978). It has also been determined that organisms can exploit a fine-grained environment in a coarse-grained manner and vice versa (see Wiens 1976, Pianka 1974), and as a result it was determined that grain relationships should also be discussed in terms of responses. Thus, we can talk about fine-grained and coarse-grained responses to environments as well. As the degree of difference between patches decreases (in a mature system) the advantage shifts toward a fine-grained response or what could be characterized as a generalist strategy. When the differences between patches are greater (in an immature system) coarse grained responses or specialist strategies are favored (Pianka 1978:263).

In reference to human exploitation patterns, it should be noted that larger animals, because of their size, "tend to encounter the world in a more fine-grained way than smaller ones." Humans, being one of the largest, most highly mobile animals in the biosphere, are able to transcend many of the limitations of patch size that smaller animals cannot. This means that humans can make use of more distant patches in an environment and can be quite flexible in their grain-responses. Depending on the qualities of resources and their distributional characteristics, humans have the option of exploiting their environment in either a fine- or coarse-grained manner. This flexibility is increased by the fact that humans are omnivorous and can assimilate a wide range of resources.

Optimal foraging is a concept based on the assumption that natural selection works to insure the survival of those species whose use of time and energy is most efficient in relation to energy returns (see MacArthur and Pianka 1966, MacArthur 1972, or Pianka 1978). In a fine-grained or homogeneous environment, where a foraging animal encounters food resources in approximately the same proportions in which they occur naturally, the array of food resources which it actually feeds on is a function of the search and pursuit times required to assimilate a particular food resources. It is assumed that an animal can exploit this environment in a coarse grained manner (it can select among the variety of potential food resources) and that if a food resource (or prey species) is selected once, it will always be selected. Under these conditions, the optimal diet of a foraging animal is determined by ranking prey species in terms of highest to lowest yield per unit of time or energy expended. Beginning with the most rewarding food resource, an optimal diet is expanded to include consecutively less rewarding species. As the diet is expanded, search time decreases per prey species because the frequency of encountering an acceptable prey species increases with the expansion of a diet in a fine-grained environment. As the diet continues to expand, however, the morphologies or escape tactics of prey species will entail increased pursuit

time. At the point where increased pursuit time exceeds the returns of shortened search time, new prey species will no longer be considered worth the added effort, and will not be added to the array of resources a foraging animal will exploit. Thus, an optimal diet will be established (see Pianka 1978:164-265).

On an individual basis, it should be obvious that organisms capable of exploiting patchy environments are generally mobile animals. Also, as the size of the animal increases, so does the potential for utilizing more patches in a geographic sense. Thus, it is larger animals such as deer or humans that are most capable of making full and efficient use of major physiographic patches, known as ecotones. E. P. Odum (1971:157) defines an ecotone as "a transition between two or more diverse communities as, for example, between forest and grassland or between a soft bottom and hard bottom marine community. It is a junction zone or tension belt which may have considerable linear extent but is narrower than the adjoining community areas themselves." The resources of the diverse communities as well as the ecotone can be used quite easily by large, mobile animals.

The relative sizes of such patches or ecotones can also affect the optimal number of patch types utilized by a given organism. Pianka (1978:268) illustrates this relationship by contrasting two environments which vary only in the size of patches; the relative proportions and qualities of prey species are not different. Within patches that are identical in all but size, hunting time remains constant, but traveling time per item will decrease as the sizes of patches increase because more time can be spent in a single patch of larger size. Traveling costs are thus reduced between patches as patch size increases. Larger patches can be exploited in a more specialized manner than smaller ones. This means that as average patch size decreases in a given environment, relative to a certain organism, it will become more difficult to differentiate patches and an organism will end up utilizing its environment in a fine-grained manner. This condition approximates a mature system in its extreme form. The repetition of nearly identical, small sized patch types creates a complete homogenizing effect. Oppositely, as patch size increases relative to an organism, the organism becomes increasingly subject to a one patch environment and a fine-grained response will be appropriate again.

Finally, predator competition can serve to affect grain response (see Pianka 1978:266, 317-318). The selection of a patch type by a forager depends on the perceived yield of that patch. In cases where the food density of a patch is decreased through competition, its exploitation becomes increasingly costly to an organism as hunting time is increased. If the cost of increased search time begins to drastically affect return efficiency, an organism may have the option to become more specialized in its patch exploitation methods.

To summarize, organisms respond to the resource structure of environments in either fine- or coarse-grained manners. Fine-grained responses to environments entail the utilization of resources of patches in direct proportion to their natural occurrence. Coarse-grained

responses by organisms entail selective use of resources or patch types. In other words, resources or patch types are not utilized in proportion to their natural occurrence in a particular environment. Environments can also be characterized as either fine-grained (homogeneous) or coarse-grained (patchy or heterogeneous). Environmental patchiness is seen to decrease, perceptually, with ecosystem maturity. Thus, immature systems are generally more patchy than mature ones. The particular response an organism adopts is a function of the perceived yields of resources relative to the relationship between the economics of consumer choice (search, pursuit and travel costs) and the dimensions of resource structure (food density, patch size and competition).

Because large animals need to assimilate greater bulk quantities of food or energy than smaller animals in order to maintain their biomass, they generally must exploit more expansive geographic home ranges (Pianka 1978:78-81, McNab 1963). The character of the food resources consumed also effects home range size. In regard to this McNab (1963) distinguishes between two types of animal feeders, "croppers" and "hunters." Croppers exploit resources which are in relatively dense supply while hunters use foods that are more scarce. Examples of croppers are those herbivores such as grazers or browsers that eat the green parts of plants (i.e. grasses, weeds, and shrub or tree leaves). Hunters correspond to carnivores and special kinds of herbivores that must search for grains (granivores) or fruits (frugivores). Croppers require smaller home ranges since their food supplies are dense while hunters are generally forced to range over extensive areas in search of their more rare food resources. Food poor environments will require home range expansion in both feeder types. One counter-balancing effect of large body size, however, is that larger animals have lower metabolic rates which means that the cost of moving a unit of body weight per distance unit is less than in smaller animals (Pianka 1978:80-81).

Preindustrial humans correspond to McNab's "hunter" type who, in combination with their relatively large body size, can be viewed as one of the most mobile species in the biosphere. Osborn (Osborn and Falk 1977) has compiled a list of daily home ranges for modern ethnohistoric hunter-gatherer groups which is displayed in Table 11.1. This table indicates that hunter-gatherers are indeed capable of high mobility on a daily basis ranging from 3 to 15 miles from their residences. The areas covered by a single group in a life time can be drastically larger than this of course. Similarly, Binford (n.d.) reports that his older Nunamiut informants indicate a first-hand familiarity with a vast area of land encompassing about 135,265 square miles. In their lifetimes they have exploited a surprisingly large area, equivalent, as Binford observes, to just under 70% of the modern territorial limits of France.

Building upon McNab's concepts, the distances which hunter-gatherers must travel place constraints on the manner in which environments can be exploited. Binford (1980) identifies these constraints in terms of mobility options. He argues that hunter-gatherers have basically two available options in responding to environmental variability. These are

TABLE 11.1 DAILY HOME RANGES OF SELECTED HUNTER-GATHERER GROUPS (EXTRACTED FROM OSBORN AND FALK 1977:106-107).

Group	Daily Foraging Distance	Source
!Kung Bushmen, Kalahari, Africa	10 to 15 km.	Yellen and Lee (1976:43)
G/Wi Bushmen, South Africa	males: 15 mile radius of base camp females: 5 mile radius of base camp	Silberbauer (1972:287)
Australian Aborigine	6 to 8 mile radius	Yergoyan (1968:187)
Pitjandjara, Australia	females: 3 miles	Tindale (1972:245)
Plains Indians	residential moves: 5 to 6 miles in a day	Ewers (1955:307)

logistical and residential mobility, options that relate to strategies concerning the proper ways in which labor groups are organized, differentiated and positioned to exploit a given environment. At the most general level logistical and residential mobility represent the social organizational options open to hunter-gatherers as responses to immature (coarse-grained) and mature (fine-grained) environments, respectively.

LOGISTICAL VS. RESIDENTIAL MOBILITY IN HUNTER-GATHERER ADAPTIVE SYSTEMS

Logistical and residential mobility can be viewed as typical hunter-gatherer responses to the grain sizes of different environments. Because of large body sizes and the characteristic "hunter" (cf. McNab 1963) feeding strategy of humans, the scale of grain size that is relevant to this discussion is quite large. Major physiographic ecotones can be considered of general importance, although smaller patches such as river systems and smaller-scaled terrestrial community variations can be of equal importance.

Logistical mobility is essentially a response to an immature, patchy or discontinuous ecosystem. The species diversity components of variety and equability are both low in immature environments. This has two implications for hunter-gatherers exploiting such an environment. First, because species equability is low, some resources (the abundant ones) will tend to exhibit clumped distributions. Second, because species variety is also low, there are not many different kinds of resources to select from in developing a feeding strategy. Thus, the ratio of the number of critical resources (those important to the continued survival of a consumer species) relative to the number of possible prey species in the environment is high. These conditions increase the chances that a coarse-grained or specialized diet will be chosen, and, that the spatial distances between at least some of the critical resources will be great. Binford (1980:10) refers to these conditions as increased spatial incongruence.

Incongruity has a temporal dimension which is ultimately linked to seasonality. Immature systems, for example, are characterized by high ecosystem instability which is principally related to seasonal fluctuation in climate. This in turn may cause dramatic seasonal fluctuations in animal populations in the temperate zones, which are subject to harsh winters (MacArthur 1972:203). Seasonal migrations in and out of an environment can create temporary conditions of both food scarcity and abundance in temperate zones. Binford (1980:10) describes this condition as temporal incongruence. Plant species in temperate regions may also give rise to temporary abundances followed by periods of little or no production. Such seasonally discontinuous production is exemplified by nut producing trees of temperate deciduous forests (i.e. oak, hickory, walnut, etc.). Massive amounts of nut seeds are produced in the fall, but are dispersed by the time winter arrives and become inaccessible as food resources unless they are stored. Thus, temperate environments are characterized by cyclical abundances and scarcities of food. Seasonal scarcities usually occur in winter and early spring. These periods pose a survival problem to organisms

in temperate environments, especially animals. Binford (n.d.) refers to this as the "over-wintering problem." Organisms have adapted to these conditions in a number of ways. The decreased angle of the sun's rays during the cooler months of the year creates a solar energy deficit in the temperate zones (see MacArthur 1972:5-9) of the biosphere. In response to this, green plants generally enter a state of dormancy where metabolic rates can remain low and the organism can maintain itself through stored energy in the phloem (Spurr and Barnes 1980). Animals cannot survive as effectively on stored energy because of their higher metabolic rates and must, therefore, rely more heavily upon their mobility. Although some animals endure periods of food scarcity through hibernation others have adjusted to such fluctuations by migrating to areas where food is available (i.e. caribou or migratory birds). Other species such as squirrels adjust by physically storing food items such as nuts.

Increased spatial and temporal incongruence of critical resource distributions are problems which hunter-gatherers generally solve with logistical mobility. Under this positioning strategy some critical resources are supplied to consumers residing in a base camp by specially arranged task groups which often travel great distances in the procurement of these resources (Binford 1980:10). The exploitation goals of these task groups are very specific and are directed toward the procurement of one or a restricted set of resources. In other words, these task groups are utilizing the environment in a coarse-grained manner and are unconcerned about random encounters with non-target resources. These specialized procurement goals can often shift seasonally so that different critical resources are targeted during different seasons.

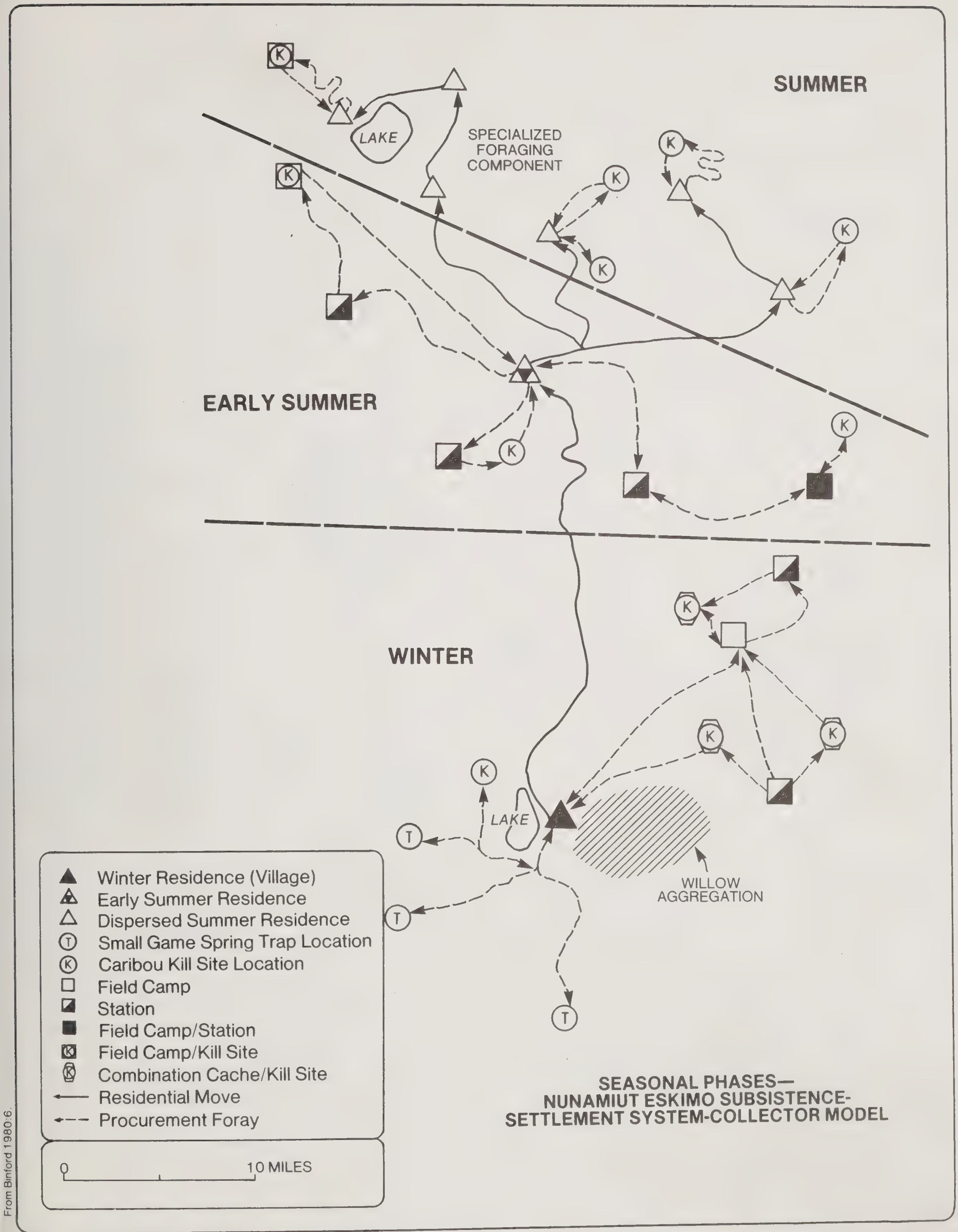
Figure 11.1 illustrates the seasonal phases of the Nunamiut subsistence-settlement system used by Binford (n.d. :22) as an example of logistical mobility. In the winter phase, exploitation is directed toward the depletion of caribou caches, occasional lone caribou kills and small game trapping. During the early summer phase, exploitation is directed toward depleting the last of the winter caribou stores, dry-storing and eating meat from spring caribou. The late summer phase is directed toward lake fishing and dispersed caribou kills. This phase exhibits the fewest logistical characteristics of the settlement system as almost all resources can be exploited without the formation of special over-night camps. In other words, the distances between special purpose sites and base camps are low; most special purpose sites are kill sites rather than camps for extended special task group expeditions. Also, needed resources are generally not stored, but are fresh. It will be seen that this phase of the Nunamiut settlement system is most like the "forager" system to be discussed next, which is characterized by fine-grained utilization of the environment.

Residential mobility is a positioning response to more mature or stable ecosystems. Immature systems such as warm deserts where seasonal incongruence of resource distributions is partially mitigated by temperature can also be exploited by residential mobility. Binford's (1980:5-10) model system for this type of mobility, is derived from the warm desert dwelling /Gwi San of South Africa. Hunter-gatherers that use residential mobility as

their dominant response to environmental conditions are referred to as "foragers" (Binford 1980:5). Figure 11.2 presents a schematic representation of the /Gwi San settlement system. Several observations about this particular forager adaptation are in order. First, the Kalahari desert is an immature ecosystem with a patchy resource structure. The /Gwi San exploit these patches (wet pans, melon aggregations, caterpillar aggregations), however, in a fine-grained manner. That is, patch types are exploited in proportion to their natural occurrence. Resources within patches are also utilized in proportion to their occurrence. This is made possible by low food density which forces an expansion of utilized patches and resources and by the absence of dramatic seasonal population eruptions like the fall and spring caribou migrations in the case of logistically mobile hunter-gatherers. Increased food density and/or temporary animal migrations increase the chances for greater patch selectivity as the need to exploit less rewarding patches or resources is decreased. This latter case might describe a savannah or prairie. Here then, is a case where low food density and relative climatic stability dictate a fine-grained response to a coarse-grained or immature environment.

The most typical forager adaptations are found in mature ecosystems where the variety and equability of species diversity are high. In this case, resource spatial distributions are basically undifferentiated and homogeneous and the stability of climate smooths out seasonal population fluctuations as well. As food density increases in mature ecosystems, grain response could shift from a fine- to a coarse-grained, but high species equability would probably dictate that the number of residential moves be frequent in either case. Thus it is likely that residential mobility would continue with increased food density.

Residential mobility, as is illustrated in Figure 11.2, involves more group translocations than logistical mobility. The entire social unit (which can vary in size and composition) is moved to a resource space. A resource space can represent a patch as it does in the /Gwi San example or it can, in more homogeneous environments, be only a radius or catchment area that has not been depleted of resources by recent exploitation. Each resource space is occupied and exploited from a centrally located residence or base camp. Resources are generally utilized in proportion to their relative frequencies of occurrence in the resource space, but are encountered and consumed one at a time. The radius of the resource space is usually not larger than the area that can be effectively exploited in a day and still allow a return to the base camp at night. Foragers rarely, if ever, store food; instead they consume what is gathered each day. The size of resource patches, when they are distinguishable, can affect the distance between residential moves as is illustrated in Figure 11.2 (see Binford 1980:5-6). Large patches can result in shorter distances between residential moves as is indicated by the large melon patch aggregation in Figure 11.2 while smaller dispersed patches and decreased resource density can result in greater distances as is illustrated by the smaller melon patches in the figure. Binford also acknowledges a logistical component to some foraging systems. This is illustrated by the round of special field camps in the lower right corner of Figure 11.2. This is more likely to occur in patchy environments than in homogeneous ones.



From Binford 1980:6.

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FIGURE 11.1
COLLECTOR SUBSISTENCE-SETTLEMENT SYSTEM-
HIGH LOGISTICAL MOBILITY

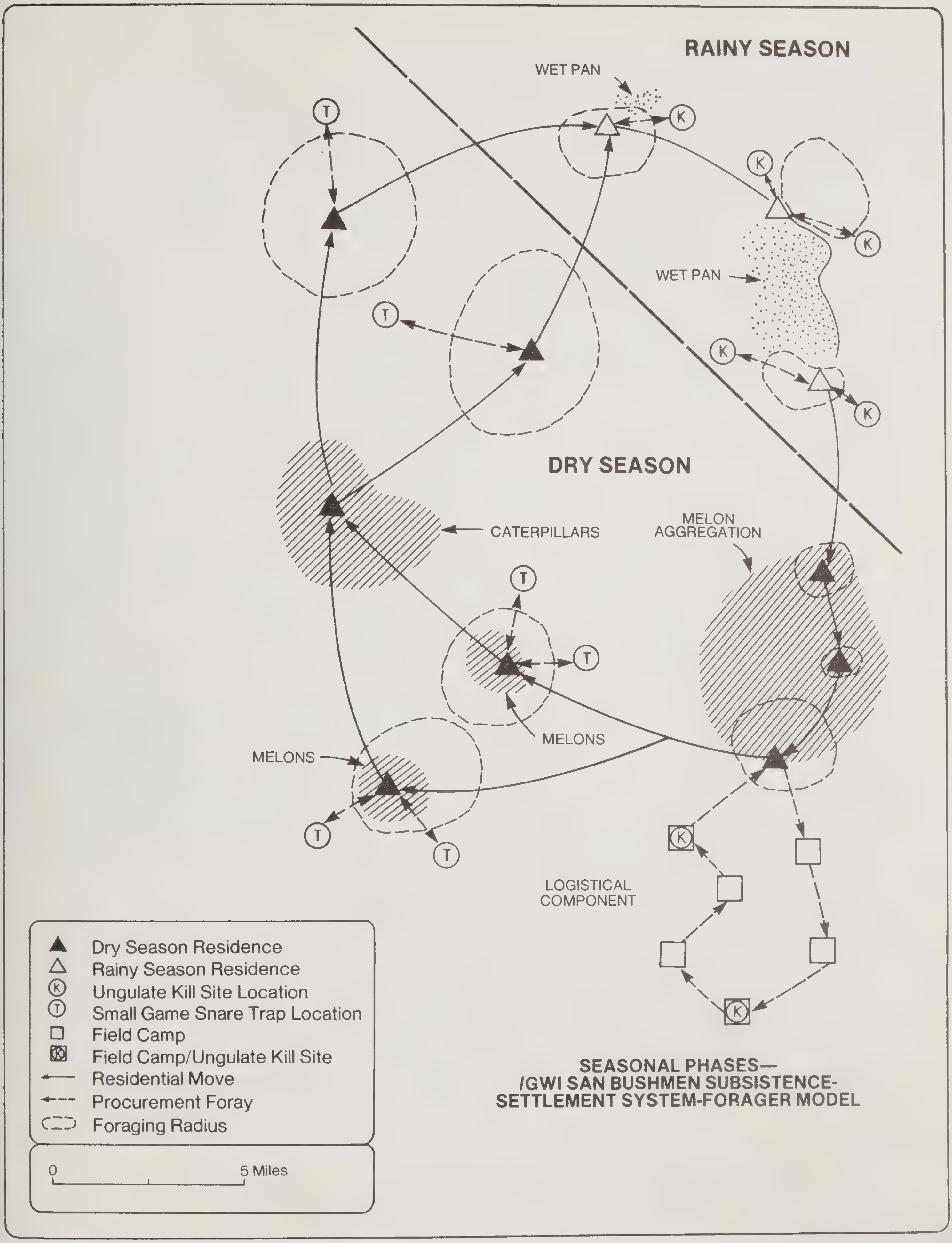

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FIGURE 11.2
FORAGING SUBSISTENCE-
SETTLEMENT SYSTEM-
HIGH RESIDENTAL MOBILITY

There is a tendency for increased differentiation of the settlement system in response to the seasonal patchiness of a desert environment. This can take the form of variation in the distance traveled between residences, differences in the duration of a residential occupation, fluctuations in the size of residential social units and can even take the form of a mixed mobility strategy as is demonstrated by the "logistical" hunting expedition illustrated in the lower right corner of Figure 11.2. Yellen (1976) describes just such a logistical expedition conducted by !Kung males who set out from Dobe to exploit an area which typically receives sporadic influxes of migrating animals. Similar logistical components can also be identified in the settlement system of the western Desert Aborigine of Australia (Hayden 1979; Gould 1980). Given the tendency for environmental "patchiness" to increase with the greater seasonality of temperate regions (MacArthur 1972: 201-205), variations in the character of settlement systems in these areas should increase. Thus, there is good cause to anticipate even greater settlement and strategic variation in the temperate foragers. Under conditions of moderate food density and/or in cases of seasonal eruptions and depletions of resources, we might expect to find an array of mixed mobility strategies in temperate settings (selectively using logistical *and* residential mobility).

Food scarcity or the inability to effectively predict the locations of prey species may appear to negate this tendency, however. In the case of the Montagnais, a north temperate forager example (see Kelly 1980), the boreal forest in which they live is a very food-poor environment. In a forested environment, most primary production is the maintenance of inedible woody tissue and is therefore largely unavailable for secondary (animal) biomass production. In northern latitudes (MacArthur 1972:5), the low angle of the sun's rays during the cold months decreases the growing season so that the net above-ground primary production is very small (see Whittaker 1975). Thus, plant exploitation is a low yield activity as well. In the winter the Montagnais are forced to subsist on highly dispersed ungulates, moose and woodland caribou, which defy locational prediction. Under these stressful conditions the Montagnais frequently are forced to move their residences to kill locations. Kelly (1980:41) estimates that the Montagnais move their residences about fifty times a year. This equals the Punan, who represent the most residentially mobile tropical forest forager group. However, because of the large home ranges of the moose and caribou which they exploit, the Montagnais must cover a vast area. Since it is less costly for a special group of hunters to monitor and locate prey, the Montagnais settlement strategy also contains a logistical component (Kelly 1980:40-41). These male hunting parties are goal directed (to find and kill a moose or caribou) and may remain away from the residence for some time in special task group organizations. Thus, although the Montagnais had one of the highest residential mobility indices of ethnographic groups, as measured by the mean number of residential moves per year, their settlement system also contained a very significant logistical component.

This example serves to illustrate just one kind of strategy mix that can occur in temperate settings. Figure 11.1 illustrates a tendency even for the Nunamiut to exhibit seasonal variability in the distance covered during logistical expeditions, the number of residential

moves, the duration of residential occupation and the size of the social unit. In the winter and early summer, the Nunamiut are aggregated in single villages and exploit the region with distant logistical forays. The differences in subsistence behavior which result are based upon frozen stores of caribou meat, small game trapping, bone grease stores and occasional dispersed caribou kills. In the early summer they subsist on dried caribou stores from the spring migrations and more frequent dispersed caribou kills. During late summer, on the other hand, the group disperses into smaller family units and more temporary residences.

The distance covered by logistical parties is comparatively small and generally does not require over-night stays away from the base camp. Resources around ponds (fish and some plants), are exploited in addition to the dispersed caribou. Spring stores are mostly used up by this time as well (see Binford 1978a). The absence of significant stores, the increased residential mobility, the exploitation of more varied and less mobile resources and the dampening of logistical expeditions all contribute to the very "forager-like" posture of the late summer settlement component of the Nunamiut.

The Nunamiut closely adhere to a pure logistical strategy, but it can be shown, as it was above, that an expansion of the very limited residential mobility component of their settlement system occurs normally during the late summer. In this instance a mixed strategy results from reasonal variation in resource structure. This is similar to the expansion of the logistical component of the /Gwi San and !Kung San, where small seasonal eruptions can be exploited using logistical mobility. Another way in which mixed strategies can be employed is as a response to cyclical or sporadic stress.

It should be noted, then, that temperate settings provide conditions which can result in mixed mobility strategies in hunter-gather adaptive systems. These "mixes" can occur as responses to normal seasonal variation in resource structure, sporadic but unpredictable population eruptions of particular kinds of resources, or in irregularly spaced stressful situations. This can cause a good deal of variation in settlement pattern and site types, which will be discussed below.

Comparing the settlement systems of collectors and foragers presented in Figures 11.1 and 11.2 it is evident that collectors are associated with a much more diverse array of site types. Binford (1980:9) recognizes two types of sites for foraging systems: 1) residential bases and 2) locations. *Residential bases* are the central nodes of activity: places where the members of a group return at night to sleep and where most processing, manufacturing and maintenance activities take place. These sites can vary with the duration of stay, the number of members in the social unit at any one time, the character of the patch or resource space being exploited, and seasonal shifts in resource exploitation. *Locations* are special purpose sites where nothing but extractive tasks are carried out. In forager systems low bulk extraction takes place on these sites and archeological outputs are low. They might be referred to

as "non-sites" in common archeological context (Thomas 1975). Extractive sites are also prevalent in collector systems, but because high bulk extraction of resources is more common, some collector locations should contain larger accumulations of debris and therefore should be more visible archeologically. Archeological examples of these sites might be Plains group bison kills, spring intercept caribou kill-butchering sites of the Nunamiut or fish wiers or camas procurement sites on the Columbia Plateau (Binford 1980:10).

Collectors also produce three other major types of sites: field camps, stations and caches. *Field camps* are temporary residences for special task groups which are occupied during logistical expeditions. The task group consumes food, sleeps, and performs maintenance activities on these sites. Therefore, field camps share many common features with residential bases, but should be distinguishable by artifactual content differences in an archeological context. Field camps should vary with the kinds of resources targeted. *Stations* are lookout points or information monitoring positions such as game ambush locations or hunting stations where the movement of animals or other relevant resources is closely monitored. *Caches* are common components of logistical systems since a major strategy of over-wintering employed by collectors is the storage of bulk quantities of food. Other resources vital to the maintenance of group members such as fuel for fires or lithic raw material may also be stored in caches. Binford (n.d.b.) observes that the Nunamiut, for example, make every effort to cache technologically related articles as they traverse their extensive home ranges so that they may serve future expeditions. In this way they can artificially modify their environment, creating greater densities of certain resources in a resource-poor environment. The Nunamiut use caching strategies to maximize the "time-utility" (Binford 1978a) of resources. In the case of caribou caching, cold and dry storage provides a mechanism whereby the highly aggregated seasonal distribution of caribou migrations can be evened out. Caching of other resources also results in prolonging their time utility. Articles that may have no immediate use on an expedition may one day be of use as a repair part or as fuel for a fire on another expedition. Similarly the caching of more lithic raw material than could be transported or used at any one time could provide a readily available source during future trips into an area. The presence of caches, though, need not imply a highly logistical system since the need to increase the time utility of resources would seem to be a concern of all kinds of human organizations. However, this principal is central to highly logistical systems and therefore caching should be a more integral part of this adaptive system than it is in forager systems where resources are usually exploited for immediate daily use.

The basic types of sites which Binford (1980) discusses are distributed across the landscape in patterns characteristic of logistical and residential settlement systems in Figures 11.1 and 11.2. However, these "site types" often occur in different combinations at a single locus as is indicated by the associated symbol keys. Thus these site types are not always independent, but can also occur as functional elements of a single occupational residence. The variety of sites is greater in logistical systems as is the complexity of the possible

combinations of these sites. Consequently, greater inter-site functional variability should be manifested in logistical systems. The character of functional redundancy of specific locations within the landscape can exhibit important differences as well. In spatially and temporally incongruent environments the factors which condition the reoccupation of a certain location for the same mode of use are stronger. For instance, the Nunamiut reoccupy certain sites for monitoring the movements of caribou. In the Kalahari the Dobe !Kung reoccupy the same area, season after season, to exploit the same resource patch. In a less heterogeneous environment such as the tropical forest, resource distributions do not exert the same influence on site positioning and therefore the criteria for site location are extremely relaxed.

The broad scale spatial consequences of such conditions, in combination with the simple site types of forager systems, work to create a very undifferentiated assemblage distribution and the chances of site reoccupation of any single spot are greatly reduced. The environment would be used in a very non-specific manner and functional variability would be low. However, this might not be manifest in inter-assemblage variability measures where site content is affected by other factors besides function including duration of stay and size of the social unit. This is true because the kinds of items discarded and their relative proportions in the record is principally a function of the use-life of tools (see Schiffer 1975), the chances of an article being discarded at any particular locus increases with the length of occupation. Thus, we might expect that interassemblage variability in forager systems will increase with the length of residential occupations (remembering that locations are generally not archaeologically visible in such systems). Collectors and "patchy" foragers would be expected to exhibit less intersite assemblage variability as the reoccupation should create fairly consistent kinds of locationally specific sites.

Differences in long-term land-use patterns are portrayed as a series of residential occupations in the most idealized of forager systems, randomly located over a homogeneous environment for a period of about fifty years (see Figure 11.3). If this idealized group were to average twenty residential moves per year the result would look similar to Figure 11.4a. The residential site locations being located randomly, there is a tendency for occasional overlap and clumping, but the general pattern is one of dispersion. Figure 11.4b portrays the long-term use of an environment by collectors (or "patchy" foragers). In such a case, residences might be moved twice a year between a summer site next to a large lake where fish and migratory fowl are exploited and a winter residence which is located next to a grove of woody shrubs used as fire fuel during the cold months (see Figure 11.4b). The locations of residences and special purpose sites are very specific as reoccupation varies only with the exact locus within a patch or landform. The inscribed triangles represent types of special purpose sites, such as look-out points or rockshelters, where the character of the landform acts to constrain locational variation. The other aggregations of triangles represent locations within the environment with varying degrees of attraction for reoccupation. The reoccupations of the winter residence are more "aggregated" than the summer residence reoccupations indicating that the topographic or patch characteristics of the summer residence do not as strongly condition the exact location.

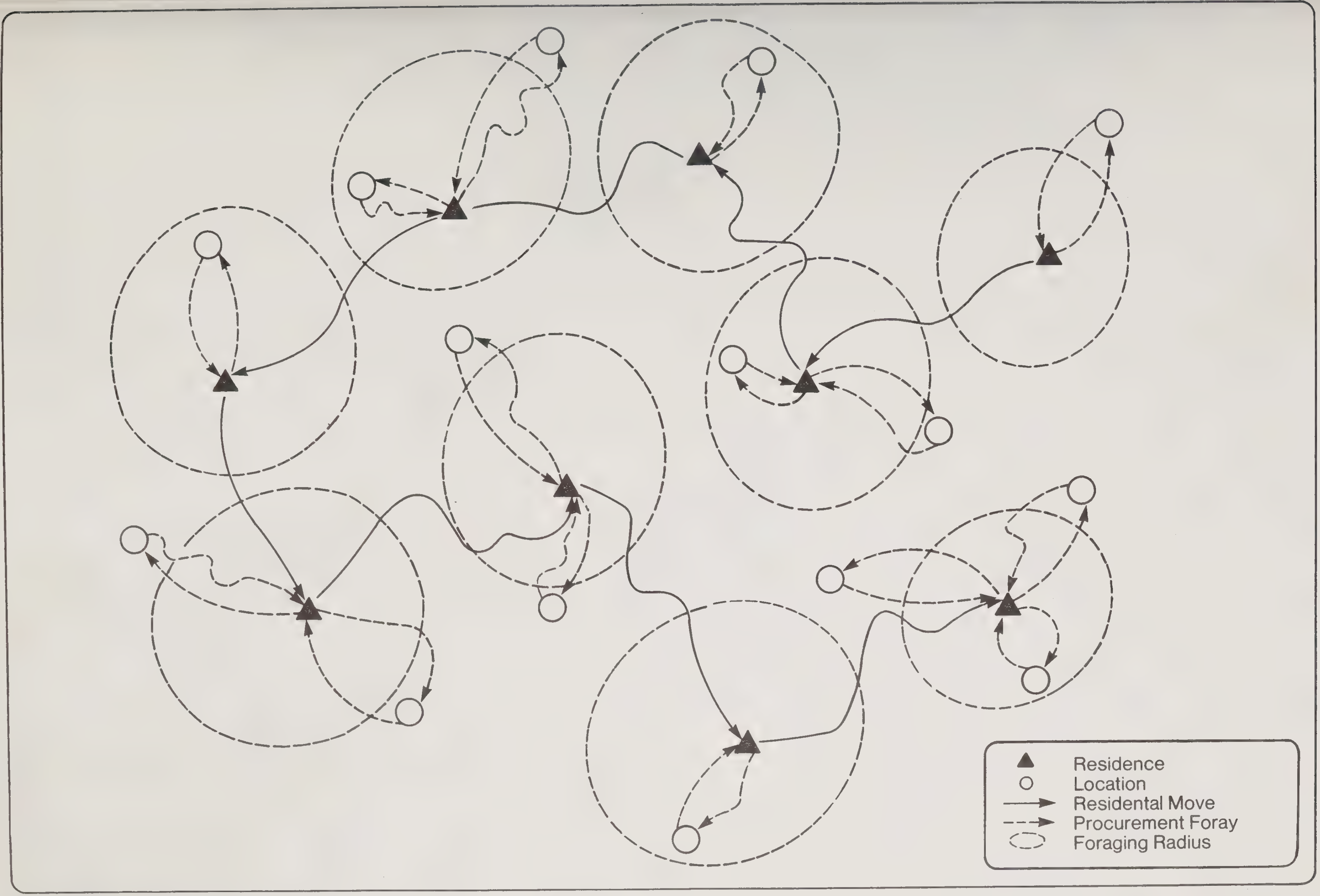

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FIGURE 11.3
IDEALIZED FORAGER SYSTEM
HIGH RESIDENTIAL MOBILITY &
LOW INTERASSMBLAGE VARIABILITY

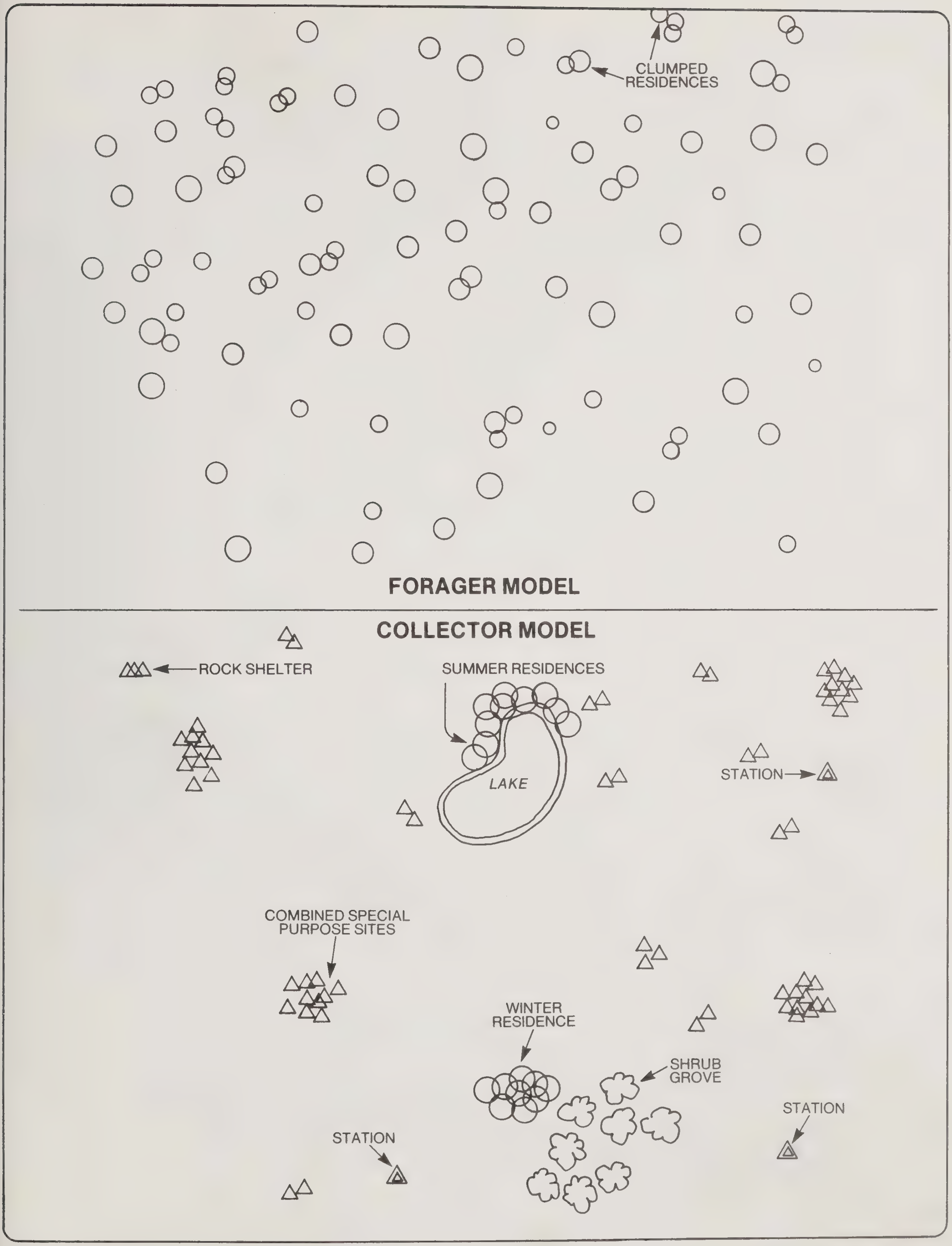

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FIGURE 11.4
CONSEQUENCES OF
LONG-TERM LAND USE

Seasonality As a Predictor of Mobility Strategy:

Having examined logistical and residential mobility strategies, and how they vary with ecosystem maturity, we are now ready to discuss the associative utility of Binford's model. High seasonality seems to be closely connected to collector adaptations, while low seasonality is connected with foragers, due to structural resource differences between unstable and stable environments. Binford (1980: 13-17, n.d.a.) has borrowed, as a heuristic device to approximate seasonality, a measurement called *Effective Temperature* (ET) developed by Harry P. Bailey (1960). The ET value of a particular area is calculated from the mean temperature of the warmest and coldest months of the year (usually July and January respectively in the Northern Hemisphere). Modern day effective temperature values range from around 8.25°C in the habitable regions of the Arctic to approximately 25.25°C at or near the equator. An important point to remember is that this value relates to global solar radiation variation and therefore corresponds closely with the latitudinal gradient of insolation. As distance from the equator (the portion of the earth closest to the sun) increases the solar rays strike the surface at increasingly oblique angles, resulting in less intense radiation and a temperature gradient which decreases toward the poles and increases toward the equator. ET has less to do with precipitation, but the moderation affects of precipitation on temperature will guarantee that some influence of humidity will be measured in calculating ET values. This cannot reflect the major differences that can occur across the globe at the same latitudes. North Carolina, for instance, is at a latitude roughly equivalent to that of Oklahoma, northern Texas, northern New Mexico, northern Arizona and southcentral California. However, it supports a vastly dissimilar ecosystem.

The major utility of ET is that it defines relative seasonal differences across a disparate array of environments. It "is a measure of both the length of the growing season and the intensity of solar energy available during the growing season" (Binford 1980:13). Effective temperature can be viewed to describe one kind of climatic gradient. It cannot reconstruct resource structure nor can it be used to predict the kind of mobility and hunter-gatherer group will employ at a given latitude. As Binford argues, however, high seasonabilty can have a dramatic effect upon human adaptive responses. These concepts are used to advantage in this study. Binford has paired calculated ET values with ethnographic groups ranked by Murdock (1967) according to their degree of relative sedentism. The four ranks are defined in the following manner:

1. fully migratory or nomadic bands
2. seminomadic, dispersed into bands for one part of the year and agglomerated in a village for the other part
3. Semi-sedentary, can have two organizational types:
   a. Villages shift seasonally, but members remain aggregated
   b. One village is occupied more or less permanently throughout the year, but a large proportion of the members depart at particular seasons to occupy smaller, more mobile settlements
4. A permanent settlement with little or no segmentation.

The degree of residential mobility (as measured by the number of residential moves made during a yearly cycle) decreases as rank number increases; higher rank numbers reflect greater sedentism. Binford's data are presented in Table 11.2. It should be clear from an inspection of the frequencies and percentages of the table that the most sedentary groups (those with a rank of 3 or 4) are overwhelmingly associated with lower ET values. In climates with effective temperature values of 16 to 25, sedentary or semi-sedentary groups comprise only seven percent of the cases, while in climates with effective temperatures below 16 they comprise almost 32 percent of the cases. However, it can also be observed that less sedentary groups (ranks 1 and 2) constitute the greatest proportion of cases in both the lower and higher effective temperature ranges. Use of ET as an associate of mobility strategy, assuming that high values of ET should relate with high residential mobility and low values of ET should relate with high logistical mobility, would result in a success rate of only 32 percent in temperate settings (ET values of 15 to 8). However, in sub-tropical and tropical settings (ET values of about 16 and above) mobility strategy could be correlated in 93 percent of cases.

Mobility in colder climates is a much more complex subject than it is in warmer ones. A larger amount of the variability exhibited in temperate hunter-gatherer mobility systems can probably be explained by some of the ecological relationships we have discussed previously. For instance, we have seen how food scarcity can move organisms in a heterogeneous environment to adopt a more fine-grained exploitation pattern (see Pianka 1978). In hunter-gatherer systems this can result in a more nomadic adaptation. High residential mobility does not preclude the necessity of employing a significant logistical component where specially organized male hunting task groups may be required to make extended journeys from the home base to monitor and procure highly mobile and dispersed game (see Kelly 1980). High residential mobility is employed to move the entire social unit to the site of a kill. Using Murdock's scheme such groups would most probably be classified as "nomadic" to reflect the frequent residential moves that are undertaken during the yearly cycle. But this would completely mask the important logistical component of their system. Therefore, it would seem that Murdock's categories, while they provide a reasonable index of residential mobility do not unequivocally describe the character of residential mobility within hunter-gatherer settlement strategies.

If we perform a statistical correlation between ET and Murdock's categories we would find that a Pearson Product-Moment coefficient (see Thomas 1976:383-438) derived from the sample in Table 11.2 (Effective Temperature values were paired against the rank values of Murdock's Categories: 1 = fully nomadic, 2 = semi-nomadic, 3 = semi-sedentary and 4 = sedentary) is only -0.22, certainly not reflective of a very meaningful correlation. Yet it is obvious that the more sedentary systems are strongly associated with temperate climates. A 2 x 2 contingency table collapsing ET values into a temperate group (8 to 15) and a subtropical/tropical group (16 to 25), and collapsing Murdock's categories into a high nomadism group (nomadic and semi-nomadic) and a high sedentism group (semi-sedentary

TABLE 11.2
CROSS TABULATION OF HUNTER-GATHERER SETTLEMENT TYPES
FROM MURDOCK (1967) & EFFECTIVE TEMPERATURE
FROM BINFORD (1980:14)

Effective Temperature	Fully Nomadic (1)	Semi-Nomadic (2)	Semi-Sedentary (3)	Sedentary (4)	Total	Index Value
25	2	0	0	0	2	
24	1	0	1	0	2	
23	3	1	0	0	4	
22	2	0	0	0	2	
21	1	1	0	0	2	
Sub-Total	9 (75.0%)	2 (16.7%)	1 (8.3%)	0	12	1.33
20	1	1	1	0	3	
19	3	1	0	0	4	
18	2	1	0	0	3	
17	1	0	0	0	1	
16	2	1	0	0	3	
Sub-Total	9 (64.2%)	4 (28.5%)	1 (7.1%)	0	14	1.42
15	2	11	2	0	15	
14	1	10	1	5	17	
Sub-Total	3 (9.3%)	21 (65.6%)	3 (9.3%)	5 (15.6%)	32	2.31
13	3	17	4	4	28	
12	1	15	8	1	25	
Sub-Total	4 (7.5%)	32 (60.3%)	12 (22.6%)	5 (9.4%)	53	2.33
11	2	15	9	3	29	
10	3	6	3	4	16	
Sub-Total	5 (11.1%)	21 (46.6%)	12 (26.6%)	7 (15.4%)	45	2.46
9	5	3	1	1	10	
8	0	1	1	0	2	
Sub-Total	5 (41.6%)	4 (33.3%)	2 (16.6%)	1 (8.3%)	12	1.91
Grand Total	35 (20.8%)	84 (50.0%)	31 (18.4%)	18 (10.7%)	168	

and sedentary), strongly supports this association (see Table 11.3). A chi-square value of 6.87 is obtained which exceeds the value associated with a significance level of 0.1 (see Blalock 1972:275-303). Thus, based on the frequency distributions in the cells we can say that there is a good chance that sedentariness is associated with temperate climates. A Yule's Q value of 0.71 indicates that the association is also fairly strong (see Blalock 1972: 298-299). To state that nomadism is associated with the subtropics and tropics, however, would ignore the large numbers of semi-nomadic groups also found in temperate settings.

It is with the semi-nomadic category that Murdock's scheme fails to describe logistical mobility. For example, hunter-gatherers in temperate areas employ mixed-mobility strategies as responses to regular seasonal fluctuations or irregularly occurring stress periods. The low correlation between ET and mobility types as reflected in Murdock's categories points out the limitations of effective temperature as a predictor variable. It is apparent, however, that high logistical mobility does not always vary inversely with high residential mobility. This is especially true in temperate settings where environmental instability creates a vast array of situations which demand quite variable responses. Variable settlement systems, with complexly interwoven mobility strategies, achieve an optimal adaptive solution to the problems presented by a particular temperate setting. It is this variation that Murdock's categories fail to address. It is necessary to know the logistical mobility index as well as the residential mobility index to properly evaluate any relationship between effective temperature and mobility patterns, something that Murdock's scheme cannot provide.

This should not, however, prevent the development of a conceptual framework to deduce the logical consequences of cool climates on ecological structure and the implications these consequences hold for human adaptive systems. Binford's major accomplishment in the use of Murdock's scheme was to demonstrate a very definite association between cooler climates and sedentariness. Similarly from the discussion of hunter-gatherer mobility patterns, stationary residences are associated with logistical mobility strategies and conversely, logistical mobility makes possible increased residential stability or sedentariness. This is not in itself surprising, but what *is* surprising is the strong association between colder climates and sedentary residences. This association denies the assumption that sedentariness results from food abundance. Rather sedentariness can occur in extremely food-scarce environments under conditions of very low human population densities, the Nunamiut being a perfect example of such a situation while hunter-gatherers might more readily employ logistical mobility in temperate environments this relationship should be examined in finer detail.

Aspects of Logistical Mobility

Temperate environments are characteriszed by a number of factors favorable to the operation of logistically based settlement systems: 1) spatial and temporal incongruence of resource structure; 2) dependence on faunal resources; and 3) primitive storage capabilities brought about by seasons with continuously cold temperatures (see Binford n.d. , 1980). Interaction of these factors creates variation in the character of the logistical strategies that are employed.

TABLE 11.3 CHI-SQUARE TEST OF ASSOCIATION BETWEEN EFFECTIVE TEMPERATURE AND MURDOCK'S SETTLEMENT CATEGORIES

Climate	Nomadic	Sedentary	
Subtropical/Tropical	24	2	26
Temperate	95	47	142
	119	49	168

Result: = 6.87, which exceeds 0.01 = 6.6439 for 1 degree of freedom.
Yule's Q = 0.71

Binford (1980a) observes that as seasonality increases, plant foods become scarce for longer periods of time. Ultimately it is selectively more advantageous for hunter-gatherers to depend on animals which are consistently available in temperate environments and represent a higher energy food source than plants (see Osborn 1978). This relationship is evident in more immature systems of temperate regions such as the prairie or tundra. Such environments can support large quantities of ungulate herbivores which provide the highest yields per unit biomass of all animal resources. Because they subsist on plants herbivores are able to assimilate larger amounts of energy than animals at higher levels in the food chain which prey on them. Animals that feed on herbivores will not store as much energy in biomass as herbivores. Thus, ungulates provide a more abundant source of animal protein than do carnivores such as felines, canines, bears and smaller fourth and fifth level carnivores such as badgers, wolverines, raccoons, etc. Osborn (1978:175-177) provides support for this argument in comparing aquatic animal resources to terrestrial ungulates. He argues that not only are aquatic resources such as marine mammals, fish and birds less numerous than ungulates because of their third, fourth and sometimes fifth level positions on the energy pyramid, but they also contain lower concentrations of protein. Therefore, aquatic resources provide lower energy yields per unit biomass than ungulates. Shellfish also represent lower yield protein resources than ungulates.

The large body size and extended life expectancy of ungulates can actually create a situation in an immature system where a unit of primary biomass can support more units of secondary biomass. In this case the body size and individual life expectancy of the primary producers (eg. grasses) are so far exceeded by those of herbivore ungulates that there is actually more food stored in herbivores than in plants (see Pianka 1978:279). For instance, an average concentration of 600 grams/m^2 of primary biomass can support 3,450 grams/m^2 of secondary biomass in the prairie grassland biome (see Table 11.4). A similar relationship holds for savannahs as well. Even the tundra has a high secondary biomass to primary biomass ratio, although the former does not exceed the later in this instance. This relationship is drastically reversed in mature or forested ecosystems. In extreme cases such as the boreal, temperate evergreen, tropical seasonal and tropical rain forests secondary biomass represents only about .03% of primary biomass (see Table 11.4).

Animal resources, especially ungulates, have played a major role in the subsistence strategies of hunter-gatherers through the course of the Holocene. Were we to rank the various biomes in Table 11.4 according to their relative food richness for hunter-gatherer exploitation on the basis of secondary biomass we would arrive at the following ranking:

1. Acacia Tropical Savannah
2. Prairie Grass
3. Mixed Broad Leaf Forest
4. Tundra
5. Desert and Semi-desert
6. Tropical Seasonal Forest

TABLE 11.4
DATA ON THE CHARACTERISTICS OF RESOURCE STRUCTURE
FOR THE
EARTH'S MAJOR BIOMES
TAKEN FROM KELLY (1980:13-29)

Biome	Net Above-Ground Primary Production ($g/m^2/yr$)	Primary Biomass (g/m^2)	Secondary Biomass (g/m^2)	NGAP/ Primary[a] Biomass	Secondary/ Biomass Primary x 100[b] Biomass
Tropical Rain Forest	1821.4	20,000	5.0	.09	.025
Tropical Seasonal Forest*	2600.0	35,000	12.0	.04	.03
Acacia Tropical Savanna	748.0	3,500	15,760.0	.21	450.0
Woodland and Scrubland*	700.0	6,000	4.7	.11	.078
Prairie Grass	146.3	600	3,450.0	.24	575.0
Desert and Semidesert*	40.0	700	44.0	.12	6.2
Mixed Broad Leaf Forest	910.6	9,000	450.0	.10	5.0
Temperature Evergreen Forest	1300.0	35,000	10.0	.03	.028
Boreal Forest	531.3	6,000	2.0	.08	.03**
Tundra	101.4	124	79.0	.81	63.7

*From Whittaker (1975), all other data from Binford (n.d.b.)

**Corrected value, originally read .003 in Kelly (1980:13)

[a]Measure of turnover rate and amount of primary production available to a large herbivore.

[b]Measure of accessibility of fauna for human exploitation (roughly a measure of dispersion).

7. Temperate Evergreen Forest
8. Tropical Rain Forest
9. Woodland and Scrubland
10. Boreal Forest

If the amount of primary biomass available for grazing herbivores, especially ungulates, is taken into consideration we see that all forests drop into the lower half of the ranking (compare the NGAP/Primary Biomass ratio in Table 11.4, Column 4):

1. Tundra
2. Prairie Grass
3. Acacia Tropical Savannah
4. Desert and Semi-desert
5. Woodland and Scrubland
6. Mixed Broad Leaf Forest
7. Tropical Rain Forest
8. Boreal Forest
9. Tropical Seasonal Forest
10. Temperate Evergreen Forest

This of course is a direct consequence of the complex web-like food chains of more mature systems where significant quantities of food are cycled through the detritus chain instead of the grazing chain. Forests generally have elaborately constructed detritus food chains which involve developed bacterial, fungal and animal (annelids and cryptozoa) webs to process and recycle dead tissue.

Several conclusions can be derived from the above discussion. First, as Binford (n.d.) argues, temperate environments create problems of seasonally incongruent food availability for hunter-gatherers. This has been framed in terms of the "over-wintering" problem. Plants generally respond to lower energy availability in winter by becoming dormant. This of course affects the rest of the food chain in rather dramatic ways. Some animals actually enter into states of hibernation, but most have developed other adaptive mechanisms to solve the "over-wintering" problem including migration and storage. Seasonal fluctuations in plant production in temperate environments also constitute a second implication for hunter-gatherers. Such fluctuations provide a situation in which it becomes more advantageous to specialize in animal exploitation as seasonal productivity become more pronounced. Concurrently the resource structure of temperate grasslands and tundra permits more favorable conditions for the production of grazing ungulates. Their position on the energy pyramid entails that they will be more numerous than the various carnivores that are located higher in the food chain and their large body sizes and high protein yield increase their utility as a resource for human consumption from the perspective of the optimal foraging model (see Pianka 1978:148-150).

These factors have significance for the operation of logistical mobility strategies in hunter-gatherer settlement systems. The large body sizes of ungulates requires that they be highly mobile and exploit a relatively large home range in order to assimilate an adequate amount of food (Pianka 1978: 78-79). For humans to exploit ungulates they must invest significant energy in search and pursuit time (McNab 1963). As environments become progressively more patchy hunter-gatherers will also have to expend increasing amount of time in commuting between patches (Pianka 1978:265), entailing exploitation of a relatively large home range in a coarse grained manner. Extensive areas are searched for a restricted number of resources. Reliance on ungulates has two kinds of effects on hunter-gatherer adaptive systems. Initially it causes subsistence strategies to become more specialized or coarse-grained. Secondly, as the home range increases hunter-gatherers are forced to rely more heavily upon logistical mobility. Logistical mobility rather than residential mobility would be appropriate under these conditions because the costs of moving an entire social unit while hunting for dispersed, highly mobile animals is prohibitive. The highly concentrated protein yield of animal meat and the advantages of finding it in large package sizes make the logistical exploitation of ungulates quite viable (Binford n.d.). The small item size and low protein yield of plants seriously impedes the development of logistical mobility as a means of procurement since transport costs over long distances would generally exceed the energy value of the resource. To procure the same amount of energy from plant resources would require a significant increase in the amount of biomass transported. In many ways, then, logistical mobility can be characterized as necessary for the procurement of highly mobile, large animals.

In summary, logistical mobility is generally more viable in colder climates where seasonal fluctuations in primary productivity make animals a more secure resource base than plants, requiring broader home ranges in hunter-gatherer settlement systems. When animal resource distributions become more aggregated and predictable, hunter-gatherers have a bulk storage option which can smooth out incongruent distributions, and make possible a combination of logistical mobility and low residential mobility. When resources are dispersed, scarce and unpredictable making a bulk storage option impossible as in the boreal forest, high logistical mobility be accompanied by high residential mobility. This general relationship between ecosystems and hunter-gatherer mobility may be applied in a consideration of early and mid Holocene hunter-gatherer adaptive systems in the North Carolina Piedmont. The following section provides a view of the changing character of the post-pleistocene environment of this region and offers a model of anticipated adaptive change based on principles of resource utilization.

A MODEL FOR EARLY TO MID HOLOCENE HUNTER-GATHERER ADAPTIVE CHANGE IN NORTH CAROLINA

The boundaries of North Carolina lie between 34° and 36.5° north latitude and 75.5° and 84.5° west longitude. The environmental variability contained within the state's boundaries closely approximates the resource options available to the various groups of prehistoric hunter-gatherers who inhabited the same general area through the course of the Holocene, although the adaptive ranges of any particular group certainly extended into adjacent states.

North Carolina consists of three major physiographic provinces spanning a linear east-west distance of approximately 800 km: 1) mountains, 2) Piedmont and 3) Coastal Plain. The Smoky Mountains in the western portion of the state reach altitudes of nearly 2100 m. The Piedmont represents a submontane plateau largely underlain by crystalline rocks. The uplands or interfluves are heavily dissected by a dendritic drainage pattern. The major river systems (Roanoke, Neuse, Cape Fear, Yadkin and Catawba Rivers) flow to the southeast from the mountains and drain into the Atlantic. In the zone of transition between the hard crystalline rocks of the Piedmont and the unconsolidated sediments of the Coastal Plain terraces, commonly known as the Fall Line (see Strahler 1964), the river valleys begin to broaden and the courses of rivers start to meander. The topography of the coastal Plain gradually flattens and descends toward the coast.

The effects of the great altitudinal, and to a lesser degree latitudinal, differences of these physiographic regions creates a good deal of climatic variability in the state. The extreme southeastern corner of the state approaches a subtropical climate while the mountains in the far west are characterized by a modified continental type. Climate at higher elevations is variable and varies most in the mountains where sub-zero (°F) degree temperatures are normal in the winter. The coastal areas are more stable due to the modifying effects of the Atlantic Ocean.

Table 11.5 and Figure 11.5 provide a summary of the climatic variability that exists today in North Carolina. There is nearly a l00 day difference in the growing seasons between Banner Elk, in the upper reaches of the mountains, and Wilmington which is on the coast. Also, there is a 2.39°C difference between these stations in terms of Effective Temperature. The greatest variation in annual rainfall is manifest between the two mountain stations, which relates to dynamics of the rain-shadow effect. Warm moisture-laden winds from the Gulf and South Atlantic drop most of their moisture over the peaks of the mountains and therefore contain little as they pass across the mountain slopes (Kichline 1941:1044). Thus, mountain slope sites such as Asheville are characteristically drier than sites of higher elevation.

Monthly distributions of precipitation are relatively even. The driest month is invariably November, and the fall and winter months in general receive less precipitation than summer months. Winter rainfall is lighter, more continuous and sometimes comes in the form of snow. Rainy and overcast days are more common. Summer precipitation usually comes in the form of thundershowers which are more intense than winter showers (Critchfield 1974:198). Although greater amounts of precipitation fall during the summer months, this period is also the time of the greatest moisture stress on plants. This is because evapotranspiration rates during the warm growing season tend to exceed precipitation. The intensity of thunderstorms adds to these problems since a greater proportion of the precipitation is lost to run-off than in winter. Soil water deficits develop rapidly during the growing season under such conditions and forest vegetation can experience advanced dessication at times (Bormann and Likens 1979:84).

TABLE 11.5
PRESENT CLIMATIC VARIABILITY IN NORTH CAROLINA AS DEPICTED FROM SIX WEATHER STATIONS
(DATA FROM CLIMATE AND MAN, 1941:1035-1036, EFFECTIVE TEMPERATURE VALUES
WERE CALCULATED BY THE AUTHOR)

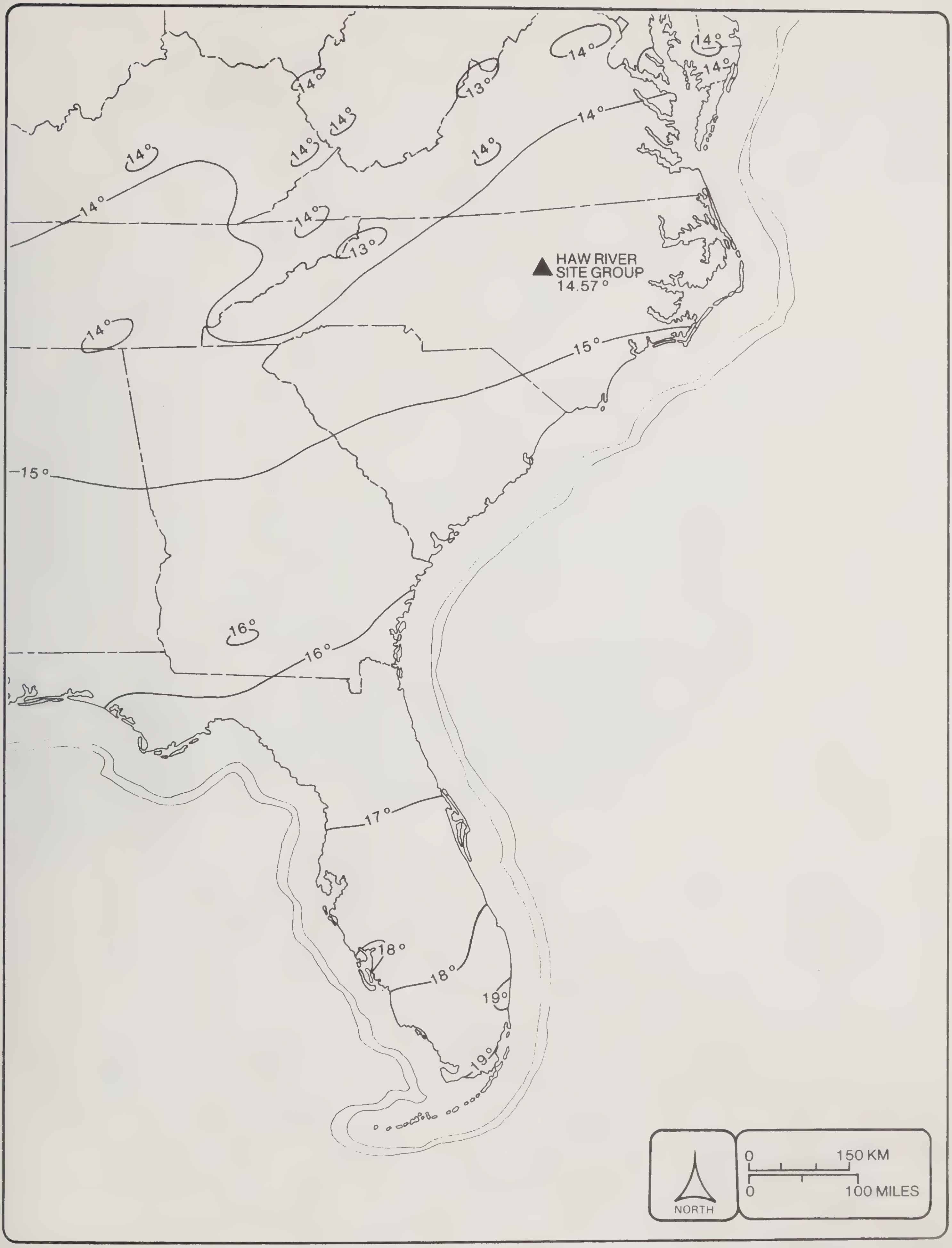
			Temperature					Precipitation (Inches)												
Station	Effective Temperature	Physiographic Association	January Average	July Average	Maximum	Minimum	Length of Growing Season (Days)	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Annual
Banner Elk	12.82°	Upper Mountains	34.4°F 1.33°C	66.4°F 19.22°C	97°F 36.11°C	-20°F -28.89°C	148	4.12	3.45	5.10	4.40	4.80	4.77	6.58	5.46	3.85	4.42	2.98	4.02	53.95 in. 1370mm
Asheville	13.83°	Mountain Slope	35.4°F 1.89°C	71.7°F 22.06°C	97°F 36.11°C	-6°F -21.11°C	194	2.73	2.83	3.79	3.07	3.18	3.89	4.17	3.86	3.04	2.79	1.96	3.16	38.47 in. 977mm
Hickory	14.29°	Interior Piedmont	41.4°F 5.22°C	77.1°F 25.06°C	99°F 37.22°C	-9°F -22.78°C	207	4.59	3.73	4.47	3.64	3.32	3.86	5.57	5.38	3.43	4.19	2.87	4.59	49.64 in. 1261mm
Moncure	14.45°	Fall Zone (Haw River Site)	42.3°F 5.72°C	78.5°F 25.88°C	106°F 41.11°C	-9°F -22.78°C	191	3.38	3.78	3.66	3.50	3.62	4.43	5.14	5.00	3.45	2.59	2.26	3.54	44.35 in. 1127mm
FayeHeville	14.79°	Interior Coastal Plain	44.9°F 7.17°C	79.4°F 26.33°C	108°F 42.22°C	1°F -17.22°C	222	3.20	3.92	3.61	3.58	3.89	5.02	5.94	5.58	4.18	2.55	2.30	3.38	47.15 in. 1198mm
Wilmington	15.21°	Atlantic Coast	46.5°F 8.06°C	79.1°F 26.17°C	103°F 39.44°C	5°F -15.00°C	246	2.90	3.31	3.11	2.73	3.22	4.49	6.95	5.96	4.89	2.66	2.10	3.08	45.40 in. 1153mm

The climate at the height of the Wisconsin Glaciation was universally drier and dramatically cooler in areas near the ice caps than today. Wright and Frey 1965; Chervin 1978; Williams 1974 and 1978; Barnette 1978; Wijmstra 1978; Duplessy 1978; Davis 1976; Fairbridge 1961 and 1972). Without pondering the reasons for glacier advance we may consider it a result of dynamics of interaction between solar radiation, atmospheric circulation and the ice caps themselves. Those areas near the advancing glaciers would have been dramatically affected by cooling processes. At the greatest extent of the last glacial advance (see Figure 11.5) the Wisconsin glacier reached as far south as southern Ohio and Indiana. This advance had significant implications for regions further south. Watts (1980:196, also see Figure 7.13) estimates that mean temperatures at or around the peak of the Wisconsin at White Pond, South Carolina were nearly 18°C (32°F difference) colder in January and a little over 7°C (13°F difference) cooler in July.

These factors had a dramatic effect on the zonal vegetational patterns. At the height of the Wisconsin glaciation in the northern hemisphere vegetation zones were displaced many kilometers south of their current distributions. Figure 11.5 illustrates Whitehead's (1973) reconstruction of the ice sheet border at its maximum extent and the distribution of major vegetational biomes at that time, based on palynological evidence. Typically boreal vegetation extended as far southward as central Georgia. North Carolina during this period constituted a major north-south ecotone between spruce and jack pine dominated boreal zones. What we will attempt to do in the remaining portion of this section is to trace the developmental sequence of environmental change, both climatic and vegetational, from this glacial point of embarkation to current environmental conditions in North Carolina with a special emphasis on how these changes might be expected to have affected the early and middle Holocene hunter-gatherer adaptive systems of this region.

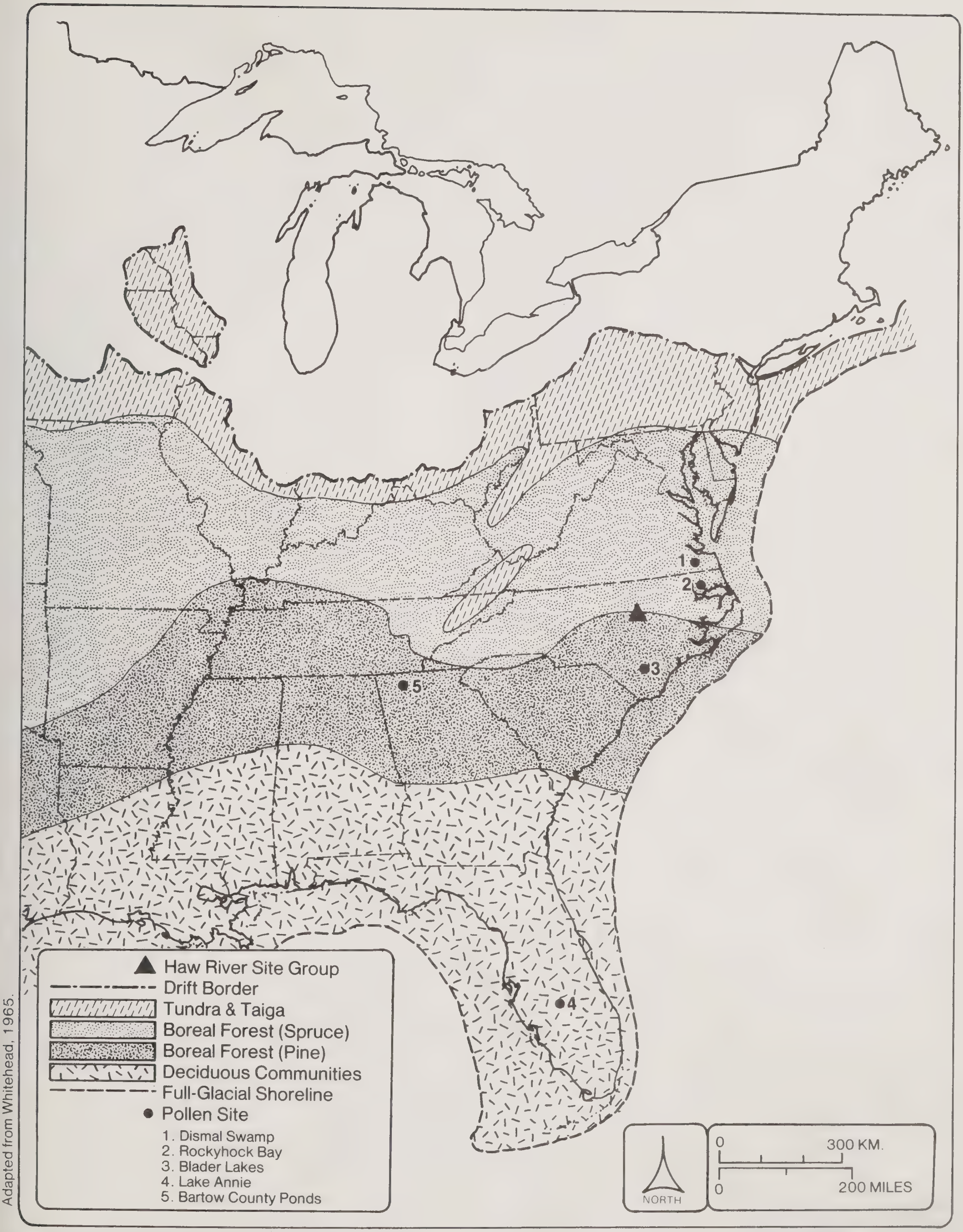
The Wisconsin glaciation began a fluctuating expansion approximately 115,000 years ago and reached a maximum around 18,000 years ago. The end of this glaciation came rather abruptly as temperatures rose swiftly, approximately 5° to 8°C, between 15,000 and 10,000 years ago (Imbrie, Kipp and Broecker 1970). Hare (1976:504) indicates that the main core of the Laurentide ice sheet, the major Wisconsin glacier of eastern North America, began to melt around 14,000 years ago and that modern hemispheric circulation, which had been depressed southward during the glaciation, was established by ca. 11,000 B.P. This latter event had the effect of spreading the post-Wisconsin migrations of species poleward and of speeding the establishment of the current day biome structure of the world. 10,000 B.P. is traditionally considered the begining of the Holocene (Davis 1976:18; Wright 1976); it is this period up until the climatic optimum or Altithermal that sees the most dramatic changes in biome structure (Wendland 1978:273, 276).

The Altithermal represents a period of time when temperatures appear to have been somewhat higher than at present (Wright 1976). The dynamics of climate during the Altithermal are not well understood at present, but several observations are clear. First, the average global insolation rate at the top of the atmosphere was greatest at around 6000 B.P.



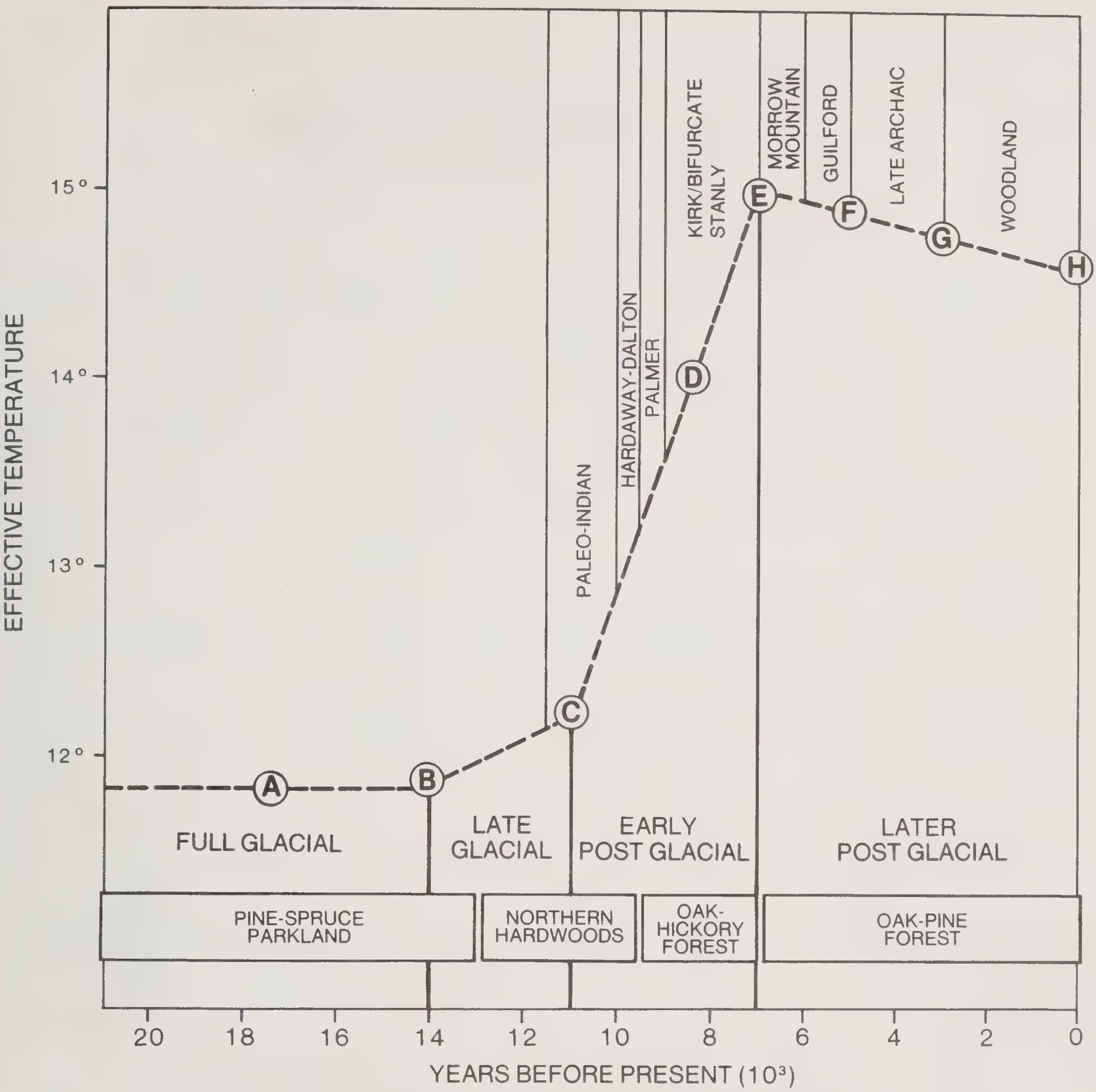
DATA RECOVERY AT SITES 31CH29 & 31CH8
B. EVERETT JORDAN DAM & LAKE
CHATHAM COUNTY, NORTH CAROLINA
COMMONWEALTH ASSOCIATES, INC.

FIGURE 11.5
PRESENT EFFECTIVE
TEMPERATURE ISOTHERMS-
SOUTHEASTERN UNITED STATES



DATA RECOVERY AT SITES 31CH29 & 31CH8
B. EVERETT JORDAN DAM & LAKE
CHATHAM COUNTY, NORTH CAROLINA
COMMONWEALTH ASSOCIATES, INC.

FIGURE 11.6
FULL-GLACIAL VEGETATION-
SOUTHEASTERN UNITED STATES



A. 11.68 ° ET derived from Watt's (1980) climatic reconstruction for the full glacial at Quicksand and Bob Black Ponds, Ga.

B. Beginning of Laurentide Deglaciation (Hare, 1976:504), 14,000yrs. B.P.

C. Attainment of modern hemispheric circulation conditions, 11,000yrs. B.P. (Hare, 1976: 510)

D. 14 ° ET constitutes theoretical threshold where it becomes more secure to rely on plant resources with increasing ET values and more efficient to rely on animal resources with decreasing ET values (see Binford, n.d.)

E. Hypothesized ET value of 15 ° for altithermal climate optimum estimated to occur around 7000 B.P. in Haw River Site Group area (see Wright, 1976)

F. 5,000 B.P. corresponds to the period of major swamp formation in southeast (see Whitehead, 1972; Watts, 1971 and Wright, 1976)

G. 3,000 B.P. corresponds to the stabilization of the modern coastline.

H. 14.57 ° ET equals modern value of Moncure, N.C. decline in ET values from points E to F represents Davis' (1976) contention that climate has grown progressively cooler and moister since the climatic optimum.

DATA RECOVERY AT SITES 31CH29 & 31CH8
B. EVERETT JORDAN DAM & LAKE
CHATHAM COUNTY, NORTH CAROLINA
COMMONWEALTH ASSOCIATES, INC.

FIGURE 11.7
HOLOCENE EFFECTIVE TEMPERATURE GRADIENTS-
HAW RIVER PROJECT AREA

TABLE 11.6
SUMMARY OF PALEOECOLOGICAL DATA FROM THE SOUTHEAST UNITED STATES

BIBLIOGRAPHIC SOURCE	SITE	LATITUDE	PHYSIOGRAPHIC PROVINCE	POLLEN ZONE	TEMPORAL RANGE	GLACIAL PERIOD	AV. JAN. TEMP (°C)	AV. JULY TEMP (°C)	LENGTH OF GROWING SEASON (DAYS)	AV. ANNUAL PRECIP. (mm)	EFF. TEMP.	BIOME DESCRIPTION
Watts (1975a)	Lake Annie, Fla.	27°12′ N	Coastal Plain, Interior Highlands	Ceratiola – Polygonella	37,000 To 13,010 Yrs. B.P.	Full Glacial						Rosemary scrub dune prairie with some sclerophyllous oak stands.
				Quercus – Ambrosia	13,010 To 4,715 Yrs. B.P.	Late Glacial – Post-Glacial						Sclerophyllous oak woodland or scrub, together with prairie rich in composites.
				Pinus – Myrica	4,715 Yrs. B.P. To Present	Post-Glacial						Long-leaf pine forest with cypress swamp and bayheads and scrub oak on fossil dunes.
Watts (1971)	Scott Lake, Fla.	27°58′ N	Coastal Plain, Interior Highlands		? To 4,360 Yrs. B.P.	Post-Glacial						Sclerophyllous oak scrub or dry forest, with prairie-like openings and essentially without pine.
					4,360 To Present	Late Post-Glacial						Long-leaf pine dominated forests with mesic broad-leaf "hammocks", bayhead vegetation and cypress swamps.
Watts (1969)	Mud Lake, Fla.	29°32′ N	Coastal Plain, Interior		8,160 To 5,070 Yrs. B.P.	Post-Glacial						Sclerophyllous oak scrub or dry forest, with prairie-like openings and essentially without pine.
					5,070 Yrs. B.P. To Present	Late Post-Glacial						Long-leaf pine forest came to dominate upland sites, and there was a more diverse flora of broad-leaf trees. Bayhead vegetation and cypress swamps.
Watts (1971)	Lake Louise, Ga.	30°43′ N	Coastal Plain, Interior		8,510 To 6,710 Yrs. B.P.	Post-Glacial						Sclerophyllous oak scrub or dry forest, with prairie-like openings and essentially without pine.
					6,710 Yrs. B.P. To Present	Late Post-Glacial						Long-leaf pine dominated forests with mesic broad-leaf "hammocks", bayhead vegetation and cypress swamps.
Watts (1970)	Quicksand & Bob Black Ponds, Ga.	34°19′ N	Ridge and Valley, Foothills	Zone Q1 (Pinus-Picea)	22,900 and 20,100 To 13,560 Yrs. B.P.	Full Glacial	-12°C*	18°C*	120*	750mm*	11.68	Coniferous forest dominated by Jack pine and spruce but with some hardwoods, especially oak and hop-hornbeam, in special mesic settings such as floodplains.
				Zone Q2		Late Glacial						Diverse forest including spruce, pine, oak, hickory, beech and hop-hornbeam.
				Zone Q3		Post-Glacial						Forest dominated by oak, with stands of more mesic vegetation zonation around lakes.
				Zone Q4		Late Post-Glacial						Mixed oak, pine, hickory forest lacking truly mesic component. Essentially modern conditions. Pine dominates.
Watts (1975b)	Pigeon Marsh, Ga.	34°36′ N	Ridge and Valley, Mountains	Pinus-herb	19,520 To 10,820 Yrs. B.P.	Full Glacial						Top of mt. unforested, below was populated by stands of Jack Pine, oak, hickory, chestnut and spruce.
				Fagus-Ostrya		Late Glacial						Mesic forest, variant of mixed mesophytic (Braun 1950). Beech dominates with oak, hickory, pine, spurce, hop-hornbeam, butternut and ironwood.
				Nyssa-Castanea		Post-Glacial						Corresponds to early/middle Holocene oak maximum and pine minimum, oak-chestnut-hickory-blackgum forest with some pine.
Watts (1980)	White Pond, S.C.	34°10′ N	Fall Zone, Sand Hills	Pinus/Picea/Herb	19,100 To 12,810 Yrs. B.P.	Full Glacial	-10°C**	19.8°C**	114**	1050mm**	12.07	Jack Pine/spruce open parkland or Savannah.
				Fagus/Carya	12,810 To 9,550 Yrs. B.P.	Late Glacial						Mesic deciduous forest. Mixed-mesophytic forest.
				Pinus/Liquidamber/ Oak subzone	9,550 To 7,000 Yrs. B.P.	Early Post-Glacial						Oak-hickory forest.
				Pinus/Liquidamber/ Pine subzone	7,000 Yrs. B.P. To Present	Late Post-Glacial						Oak-pine forest.
Whitehead (1973)	Rockyhock Bay, N.C.	36°09′ N	Coastal Plain, Carolina Bay		20,000 To 11,000 Yrs. B.P.	Full Glacial						Boreal forest dominated by spruce, Jack and/or red pine, and fir.
					11,000 To ? Yrs. B.P.	Late Glacial						"Northern hardwoods" type forest.
						Early Post-Glacial						Oak-hickory forest.
						Late Post-Glacial						Swamp forest on peat surface.
Whitehead (1967)	Singletary Lake, N.C.	34°49′ N	Coastal Plain, Carolina Bay		<40,000 To >11,000 Yrs. B.P.	Full Glacial						Open, pine dominated Savannah.
					Just Before 11,000 Yrs. B.P.	Late Glacial	-5.7°C***	19.6°C***	125***	980m***	12.23	"Northern hardwoods" type forest.
					Sometime After 11,000 Yrs. B.P.	Post-Glacial						Oak-hickory-pine.
Whitehead (1972)	Dismal Swamp, Va.	36°34′ N	Coastal Plain, Swamp Marsh	Pine-spruce	Prior To 10,600 Yrs. B.P.	Late Glacial						Pine-spruce forest, possibly boreal Savannah.
				Beech-Hemlock-Birch	10,600 To 8,200 Yrs. B.P.	Early Post-Glacial						"Northern hardwoods" type forest
				Oak-Hickory	8,200 To 3,500 Yrs. B.P.	Post-Glacial						Upland oak-hickory forests.
				1. Grass-limnophyte subzone	8,200 To 6,000 Yrs. B.P.							Beginning of swamp formation, ponding.
				2. Orontium-composite fern spore subzone	6,000 To 3,500 Yrs B.P.							Peat accumulation, swamp partially dry
				Cypress-Gum	3,500 Yrs B.P. To Present							Expansion of swamp forest

*Estimate suggested by Watts (1970) using modern climatic conditions in northern Maine as an analog.

**Estimate derived by Watts (1980) based on climatic conditions associated with modern distribution of Jack Pine.

***Estimate given by Watts (1980) utilizing modern climate conditions in the Alleghany Plateau as an analog.

(Kukla 1978:128), sufficient to raise summer temperatures about 2° to 3°C higher than today between 7000 and 5000 B.P. Second, the Altithermal appears to be generally time transgressive with latitude (Wright 1976:591), so that it occurred earlier in more southerly regions in North America. Wright (1976:594) estimates that the Altithermal terminated between 7000 and 6000 B.P. in the southeastern United States. However, the mechanisms by which this phenomenon was made time-trangressive have not yet been satisfactorily explained. Another problem in interpreting the climate of the Altithermal is the relationship between increased temperature and precipitation. Typically this period is viewed not only as slightly warmer than today, but also slightly drier (Watts 1971 or Wright 1976). This of course may not necessarily mean that precipitation decreased because evapo-transpiration rates increase automatically with temperature, creating moisture stress even under the same precipitation regime. On the other hand, a change in precipitation pattern can also create moisture stress even if the total amount of precipitation remains unchanged. At this juncture, it appears certain that the Altithermal represents a period of higher temperatures than today, but the effects of this climate dynamic were complex and varied from region to region depending upon the character of atmospheric circulation, moisture relationships and their interaction with variations in solar radiation. A rather steep gradient of temperature increase began around 15,000 to 14,000 years ago, and rose sharply after about 11,000 to 10,000 B.P. This ended when temperatures appear to have decreased slightly since the climatic optimum to their present day levels (Davis 1976; Wright 1976).

The conclusion drawn from this body of literature is that the early to middle Holocene climates of North America experienced a dramatic gradient of increasing temperature. In terms of our arguments concerning the relationships between climate, resource structure and hunter-gatherer mobility strategies, this gradient is of critical interest in modeling organizational change. To focus these observations and to produce a predictive framework for Holocene hunter-gatherer change in North Carolina, this generalized gradient was structured as an Effective Temperature gradient, reflecting the various distinctive climatic events of the Holocene (see Figure 11.7). Based on Watt's (1970) estimates for the full glacial at Quicksand Pond, which has a modern Effective Temperature equal to that of the Haw River site group area (an Effective Temperature of 11.68° is estimated for the full glacial). Temperatures gradually began to rise after 14,000 years ago. By 10,000 to 11,000 years ago modern atmospheric circulation was established and temperatures are believed to have risen sharply to the peak of the Altithermal. The climatic optimum is regarded as a period when temperatures actually exceeded those of today; an estimate of 15° Effective Temperature is used to approximate this peak. Temperatures have gradually decreased to the present ET of 14.57° at Moncure, N.C. Oscillations in temperature regimes are known to have occurred through the time period covered by our discussion (see Wendland and Bryson 1974 or Denton and Karlen 1973), but this variation would only complicate an already complex problem. Therefore, at present we will view the Holocene gradient in a simple, linear fashion.

The gradient model suggests some questions about early to middle Holocene adaptive change in North Carolina compared to the general model of hunter-gatherer mobility strategies. During this period there was a shift from growing seasons of fewer than 140 days (12.82 ET = 148 days) to around 230 days (15.21° = 246 days) at the height of the Altithermal. In terms of Binford's (n.d.) observations, we should expect a shift in subsistence strategies from an early dependence on animals to a dependence on plant resources by the middle Holocene. Secondly, the colder temperatures of the early Holocene would enhance the effectiveness of freeze storage of foods. Dry storage, always an option, is less effective in moist climates such as of the Southeast, because moisture increases the bacterial decomposition of stores (see Binford 1978:92-93). It can be assumed that storage in general would have constituted a more feasible subsistence strategy in the earlier portions of the Holocene rather than later in the Middle Holocene. Additionally, as the optimal foraging model predicts, since a greater number of seasonal environments are generally more heterogeneous in structure, we might anticipate a shift from coarse-to fine-grained exploitation of the environment from the early to middle Holocene concurrent with the perceived environmental changes. Therefore, we can state with some confidence that most of the factors which would favor logistical strategies of mobility were present in the early Holocene environment. If we can use the 180 day growing season (= 14° ET) as a theoretical flux point from which to predict when climatic conditions would have shifted in favor of residential mobility strategies, we can see from Figure 11.5 that this shift should have occurred sometime between the Palmer (or Kirk corner-notched) period and the small Kirk corner-notched/bifurcate period in central North Carolina. From this we surmise that the first signs of pressure to alter a basic logistical strategy occurred in the Palmer period, and that a basic residential strategy should have been completely manifested by the climatic optimum.

A major factor which would modify these expectations is the fact that we are essentially dealing with temperate deciduous forests throughout this long span of time. Forested environments are more mature and, therefore, resource distributions are more homogeneous. Homogeneous environments promote fine-graned exploitation strategies (see Pianka 1978) and, therefore, create conditions conducive to foraging strategies incorporating high residential mobility. Although climatic factors in the early Holocene promoted logistical strategies vegetational factors may have presented opposing pressures favoring residental strategies.

This points to a very salient characteristic of temperate forest hunter-gatherers: they must resolve conflicting situations of resource structure with mixed mobility strategies. We have discussed previously some of the mixed strategies used by hunter-gatherers in other kinds of environments, but there are no examples of mid-latitude temperate forest groups from which to draw models describing the nature of these mixes. Returning to Table 11.2, it should not be surprising that Binford (1980) had difficulty categorizing hunter-gatherer mobility strategies of ET values ranging from 12.25° to 15°. It may be that seasonality plays

a major role in strategy mixes at mid-latitudes; perhaps it is more secure to exploit the environment in a fine-grained manner during the growing season, and in a coarse grained manner in the winter, depending on animal resources. Such high level questions, though, must await further conceptual development to allow the differentiation of strategies within single systems.

In this study we choose to address a simpler set of questions concerning gross changes in adaptive organization through the early and middle Holocene and treat them from the perspective of lithic variability. In other words, we desire to see how the elements of technical organization, as manifest in lithic technology, vary in relation to the set of expectations generated about hunter-gatherer subsistence-settlement systems and mobility strategies. We approach this discussion from the perspective of gear organization as discussed in detail in Chapters 4 and 9. A brief summary of the characteristics of personal and situational gear are given here to facilitate generation of a set of expectations for the lithic technology. Personal gear is generally carried by an individual in anticipation of future conditions or activities, and can be viewed as specific, goal-determined equipment. Three principal types of personal gear in the lithic technology were discussed here: projectile points, bifaces and endscrapers. Situational gear is by contrast responsive in nature and is generally used in situations which are unanticipated or where the timing of an anticipated activity cannot be predicted. Situational gear for the purposes of this discussion was represented by the various kinds of flake tools.

A basic question addressable with the data concerns the implications of coarse-and fine-grained exploitation of environments. Fine-grained exploitation entails encountering and consuming resources in proportion to their actual occurrence in an environment. Coarse-grained exploitation entails a specialized feeding strategy where resources are utilized disproportionately to their frequency of occurrence in an environment. These two grain responses should have different implications for technological systems. In the case of fine-grained exploitation, the diversity of resources exploited is high and the timing of any single procurement event is unpredictable. The chances of encountering one resource during foraging is no greater than the chances of encountering any other resource. Under such conditions we might expect the extractive technology of a hunter-gatherer group to be overwhelmingly "responsive" in nature. Also, the diversity of tool forms should be high as the number of different kinds of resources exploited increases. By contrast, coarse-grained exploitation specializes in a narrow range of resources and the technological system should exhibit a higher degree of goal-directed implements. Coarse-grained exploitation strategies are generally directed toward animal exploitation and as the predictability of these resources increases we should expect increased goal-directed elements in the technology. Therefore, we might expect an increase in the proportion of personal gear in the assemblage and an increased formalization of design.

Applying these expectations to the Haw River sequence we observe the following trends (see Table 11.7).

TABLE 11.7 SUMMARY OF ASSEMBLAGE DIVERSITY TRENDS IN THE HAW RIVER SITE ARCHEOLOGICAL SEQUENCE

		Personal Gear					Situational Gear					
		Projectile Points	Endscrapers	Thin Unifacial	Thick Unifacial	Denticulate	Serrated Edge		Marginal Bifacial	Flake Adze, Chisel		Percent Situational Gear
Lamella 16	n	2	5	11						3		67%
	%			79%						21%		
Lamella 15	n	7	14	27	16		1		13			
	%			47%	28%		2%		23%			
Lamellae 14/13	n	7	10	38	4	6	5		3	1		77%
	%			67%	7%	11%	9%		5%	1%		
Lamellae 12/11	n	9	16	31			12		2			75%
	%			69%			27%		7%			
Lamella 8	n	24	2	84		9	8	6	12	3		82%
	%			69%		7%	7%	5%	10%	2%		(84%)*
Lamellae 7/6	n	50	3	83	15	7	7	30	13	2	20	77%
	%	(22%)*		47%	19%	4%	4%	11%	7%	1%	11%	(80%)*
Lamellae 5/4	n	34	1	28	13	10		4	5	1	7	68%
		(37%)*		41%	19%	15%		6%	7%	2%	10%	(81%)*

* Percentage figures in parentheses under "percent situation gear" is an adjusted value taking into account the situational production of personal gear.

* Parenthetical figures represent percent of Morrow Mountain projectile points that were situationally produced.

1.) The percentage of situational gear in the assemblages increased in a roughly gradual manner from a low of 67 percent in the Hardaway-Dalton occupation to a high of 82 percent in the St. Alban's/Small Kirk corner-notched horizon. Lower percentages in the later occupations were offset by the fact that large quantities of items of personal gear, principally projectile points, were situationally produced by that time. Adjusted percentages indicate figures equivalent to those from lamella 8 and substantially higher than earlier occupations.

2.) Personal gear became increasingly less formalized through time. Classic tear drop endscrapers described by Coe (1964) are virtually absent from assemblages after the lamellae 12/11 occupation and design constraints on their manufacture exhibit an increasingly relaxed condition after lamella 15 as discussed in Chapter 9. In the projectile point class, situationally produced Morrow Mountain I types represent 58 percent of the Morrow Mountain point cluster.

3.) There is a marked increase in the functional diversity of situational gear types through time. Not only does the number of different tools increase, but the relative importance of these new tool types in the assemblage increases as well.

All three of these results indeed suggest that there was a general move from coarse-grained exploitative strategies in the early Holocene to finer-grained patterns as the climatic optimum was approached. The more difficult question involves explaining the manner in which exploitation articulates with mobility strategies. It has been argued that within the colder environments of the early Holocene coarse-grained exploitation provided conditions more conducive to storage, and animal dependence, but how these factors were integrated into a forest oriented adaptive strategy is a question of some complexity. The manner in which hunter-gatherer systems changed from one kind of organization to another (particularly on a seasonal basis) is an even more complicated subject. In order to address problems of this nature we must continue to ask questions about how seasonality enters into the formula of mixed mobility strategies and how prehistoric hunter-gatherers responded to decreased seasonality over time.

The preceding discussion of the relationships between mobility strategies and resource structure was not intended to exhaust all possible examples of settlement variation, but is meant to examine the major principles of hunter-gatherer mobility options. Characterizing these options in terms of a general dichotomy between logistical and residential mobility provides a framework for generating expectations for the formation of the archeological record. From this perspective logistical and residential mobility are conceived as sets of cultural formation processes (see Schiffer 1976 or Binford 1977) which contain viable implications for the manufacture, use, loss and discard of items which comprise the archeological record. Those are the "structured consequences" (Binford 1978b) of the operation of hunter-gatherer mobility strategies as discernible in static patterns of archeological remains.

This discussion has proceeded independently of considerations of natural site formation processes (see Wood 1978 and Schiffer 1976) and factors of disturbance which were examined earlier in the report. We are not suggesting that the archeological record can be understood solely as a consequence of cultural formation processes, but rather that it cannot be understood without a clear and separate explanation of those factors. Natural formation processes and factors of disturbance cannot explain cultural phenomena. Their analytical utility is to inform on the degree of completeness of patterning in the archeological contexts created by cultural formation processes. Since we are primarily interested in explaining cultural phenomena, the present discussion has been limited to considerations of how past human behavior relates to patterned regularity in the archeological record.

CHAPTER 12

SPATIAL ANALYSIS OF ASSEMBLAGES

SPATIAL ANALYSIS OF LITHIC TOOL DATA FROM 31CH29

Introduction

Spatial analysis, recently referred to as "a process of searching for theoretically meaningful patterns in spatial data" (Kintigh and Ammerman 1982:31), is an important element of archeological inquiry. Space has long been recognized, of course, as a major dimension along which cultures may vary. The recent trend toward quantification in archeological analysis has had a marked effect on archeologists' study of spatial data. However, the applied quantitative techniques have been largely borrowed from geography and quantitative plant ecology and have brought with them a set of assumptions that may or may not always be properly applied in the archeological case. At present, there are few alternatives. Hietala and Stevens (1977:539), for example, have criticized archeologists for focusing on only certain aspects of spatial analysis, but have nevertheless based their approach on the same techniques used by many other investigators. The heuristic approach as an alternative has only recently been introduced (Kintigh and Ammerman 1982) and cannot yet be evaluated. The search for meaningful patterns in the spatial data at 31Ch29 and 31Ch8 therefore is approached here in a "traditional" quantitative manner, using procedures similar to those described by Dacey (1973).

Archeologists consider the quantitative analysis of spatial pattern to be a three step procedure: 1) determination of whether distributions are regular, random, or clustered, 2) the examination of association between categories of artifacts, and 3) the description of the artifact clusters on occupation floors (Whallon 1973a:266-267; Price 1978:3). The first of these is numerically straightforward, but can be troublesome to interpret. It is generally accomplished by positing a theoretical random process and measuring a particular pattern against it. The theoretical random process would distribute items (tools in the present case) such that each map location has an equal chance of receiving an item. A real world interpretation of this theoretical random process may be difficult.

Usually, the archeologist hopes to reject the hypothesis of a random pattern and to find objects clustered in space. However, an interpretation of clusters can be no less difficult than trying to assign real-world meaning to a random distribution. Just because the enactment of a particular behavioral set at a locus may be expected to generate a clustered distribution of tools does not mean that an observed clustering was generated by the enactment of that behavioral set, or in a more familiar parlance, clusters of tools cannot necessarily be inferred to represent activity areas.

The spatial analysis of assemblages recovered at 31Ch29 and 31Ch8 is directed toward the elucidation of a model of hunter-gatherer organization described in Chapter 11. We recognize, however, that other factors may also produce or contribute to the observed distributions and in our discussion we have described those of most relevance.

Technique

Spatial analyses of assemblages from 31Ch29 and 31Ch8 employed three major classes of artifacts: curated tools (or personal gear), expedient tools (or situational gear), and, where applicable, ceramics. An additional analysis of individual groups of ceramics from 31Ch8 was also performed. Morphological classes of lithics and individual specimens assigned to each class are described in Chapter 9. Vertical provenience was assigned by lamellae, also as designated in Chapter 9. Horizontal provenience was established within series of contiguous 1 x 1 m squares.

The first step in the analysis was the detection of the form of patterning; i.e., whether regular, random, or clustered. For this, the variance/mean ratio technique was employed. Most spatial analyses in archeology, as well as geography and plant ecology, use the variance/mean ratio to identify pattern in cases where data were collected by quadrats (i.e., grid squares). The statistic is based on the property of the Poisson distribution that the variance and mean are equal. It therefore functions in the same manner as a goodness-of-fit to a Poisson distribution and is computationally considerably simpler (see Pielou 1977:124-125; Hodder and Orton 1976:33-34; or Dacey 1973:321 for further discussion of the variance/mean ratio).

Variance/mean ratios were then tested to evaluate the differences from the value of 1.00 that might be expected if the pattern were random. This was done by computing the ratio $X^2 = nv/m$, where n = number of quadrats, v = the sample variance, and m = the sample mean, and comparing X^2 with tables of the probability that the chi-squared distribution has an equal or smaller value (cf. Dacey 1973:321). In all cases a $p \geq .95$ that the chi-squared value is equal or smaller (i.e., $p \leq .05$ that the chi-squared value is larger) was set for rejection of the null hypothesis of a random distribution.

It is a well-known fact, however, that an observed pattern is strongly dependent upon quadrat size. For example, Kershaw (1964; see also Haggett 1965:199 or Hodder and Orton 1976:37) has diagrammed an example in which smaller quadrat sizes show mild clustering, an intermediate size quadrat shows the strong clustering that is intuitively apparent, and large quadrat sizes show a regularity of distribution of points. Several techniques are available to counteract this problem. One is the use of distance measures, particularly the nearest-neighbor statistic, to avoid quadrats altogether. Its use, of course, requires precise point data, which are not always available, and may be severely affected by one or more extreme cases. Further, its use requires estimation of area and this has proved to be an

exceedingly troublesome problem (see Pinder, Shimada, and Gregory 1979 for a discussion). The second alternative is the use of a technique that has been called dimensional analysis of variance in the archeological literature (Whallon 1973a, b), but is also derived from ecology (e.g., Pielou 1977:140-144). However, this technique also has serious drawbacks (listed by Pielou 1977:141-142 and briefly discussed by Whallon 1973a:267-268). It is partially in response to problems presented by both of these techniques that Kintigh and Ammerman (1982) have presented their heuristic approach. This became available only as the present analysis was being completed so it has been necessary to confront the quadrat size problem in a more pragmatic fashion.

The quadrat size problem is, of course, one of scale. To avoid the recognition problem described by Kershaw (1964) and discussed earlier we have varied quadrat size by combining grid units. Means, variances, variance/mean ratios, and X^2 values were then recalculated for each of the larger grid sizes.

The next step in the analysis was the computation of correlations between curated and expedient tools, and between each of these classes and ceramics when applicable. Technically, we do not expect to detect an association between artifact classes that individually appear randomly distributed (Hietala and Stevens 1977:540), however, the bulk of the calculations were performed using a program written in BASIC specifically for this analysis and it was computationally more efficient to compute correlations in a single run with the other statistics. The presentation of results therefore includes all correlations, in full knowledge that some of them are of little interest.

Spatial Analysis

The analysis of assemblages from 31Ch29 considered only Archaic levels and therefore included only curated and expedient tools. Vertical provenience was by lamellae as defined in Chapter 9. Horizontal provenience was initially by 1 x 1 m squares of which 144 were excavated in Block A. These squares were progressively combined into blocks of 2 x 2, 3 x 3, 4 x 4, and 6 x 6 m squares to examine scale of clustering. The results of this analysis are described for each individual lamella or pair of lamellae.

Lamella 16 – Hardaway-Dalton – Only 20 tools were entered in the analysis of lamella 16. This included 12 curated tools and 8 expedient tools, for a curated tool/expedient tool ratio of 1.5:1. Means, variances, variance/mean ratios, and correlations for each grid size were computed as:

Grid	curated tools			expedient tools			
Size	m	v	v/m	m	v	v/m	r
1 x 1	.08	.09	1.09	.06	.07	1.20*	.21*
2 x 2	.33	.40	.83	.22	.24	1.06	.12
3 x 3	.75	1.13	1.51	.44	.53	1.21	.11
4 x 4	1.33	1.50	1.13	.89	.61	.69	.22
6 x 6	3.00	1.33	.44	2.00	4.00	2.00	.58

Note: Critical values of chi-squared are 172.72, 50.97, 26.30, 16.92, and 9.49 for 144, 36, 16, 9, and 4 cases (143, 35, 16, 9, and 3 degrees of freedom), respectively. The tables for this and all subsequent lamellae do not present the actual computed X^2 values, rather dividing the chi-squared critical values by the number of cases, we obtain the critical values of v/m which are, respectively, 1.1994, 1.4158, 1.6435, 1.8799, 2.3719. Values presented in the tables are rounded to 2 decimal places; decisions to accept or reject the null hypothesis of a random distribution were made using at least 4 decimal places. Those values which are starred (*) are those for which the probability of a chance occurrence is less than .05.

Only for expedient tools in a 1 x 1 m grid might we reject the null hypothesis of a random distribution. In other words, each curated and expedient tool was apparently discarded in such a manner that any part of the site was as likely as any other to receive it. The effect of increasing grid size was such as to reinforce this interpretation, i.e., the distribution appears random at all larger grid sizes as well. The appearance of a barely non-random (clustered) distribution of expedient tools is due to the fact that two of 8 expedient tools were found in the same 1 x 1 m square (Figure 12.1). Since we have rejected the hypothesis of a random distribution of expedient tools, it would be contradictory to refer to this association as fortuitous. The lack of clustering at a larger scale suggests that this association is not part of a larger concentration of tools in one part of the block, however.

The value of the correlation between curated and expedient tools is .21 which for 144 cases (142 degrees of freedom) has a probability less than .05 of occurring by chance. Examining Figure 12.1 we see that one curated tool (an endscraper) was found in the same square as the two expedient tools (both thin unifaces), and that one each of curated tools and expedient tools (an endscraper and a thin uniface) were also recovered in a single square. Overall, therefore, tool associations occur both within and between classes, but such associations are noticeable only at the smallest scale of measurement used and are probably not reflective of highly organized use of space at 31Ch29 by the Hardaway-Dalton occupants.

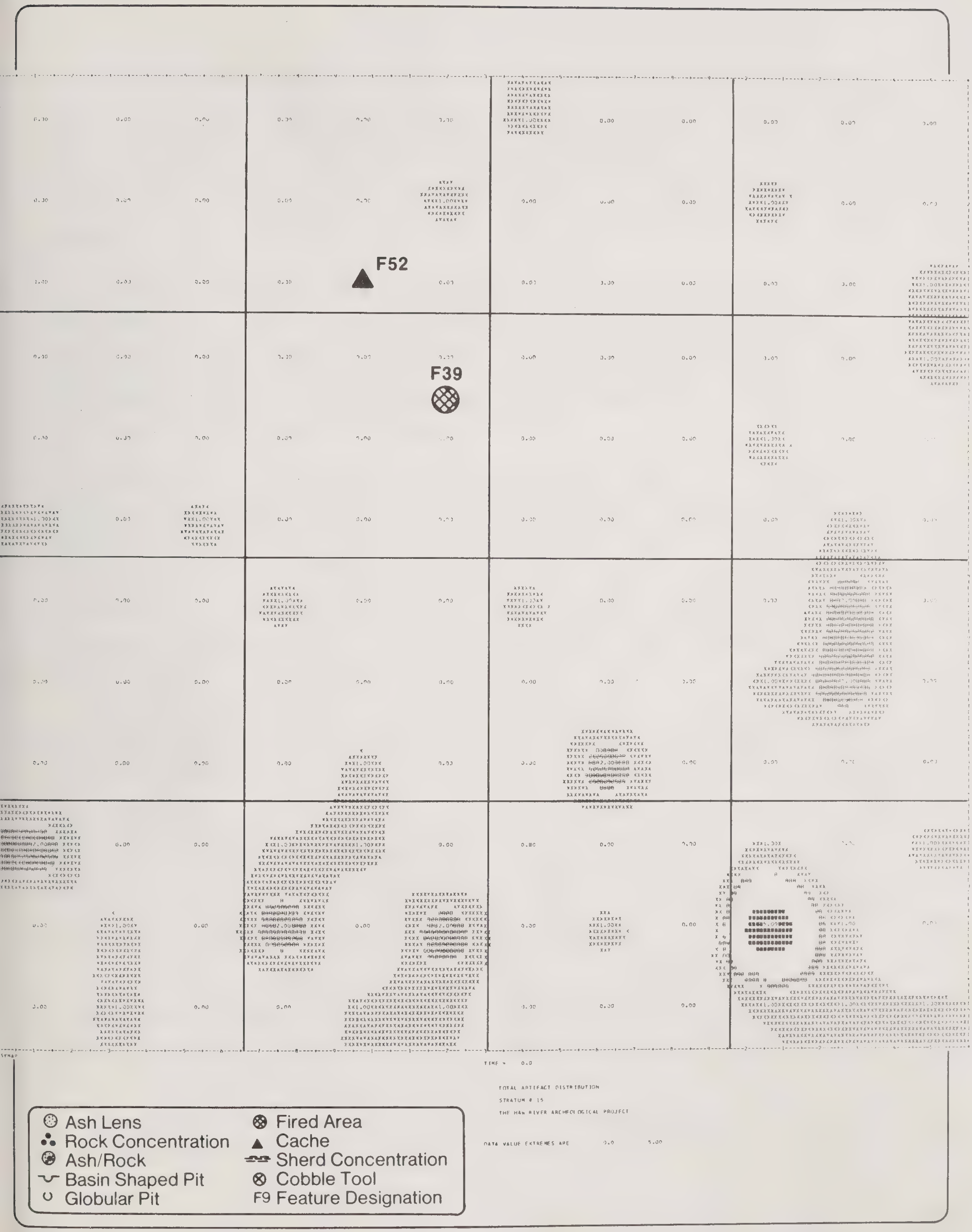
Lamella 15 — Palmer I — The number of tools from the Palmer I floor that were entered into the analysis is 52. This includes 28 curated tools and 24 expedient tools, or a curated tool/expedient tool ratio of 1.16:1. Means, variances, variance/mean ratios, and correlations were computed as:

Grid	curated tools			expedient tools			
Size	m	v	v/m	m	v	v/m	r
1 x 1	.19	.24	1.24*	.17	.22	1.34*	.10
2 x 2	.78	1.03	1.33	.67	.80	1.20	.04
3 x 3	1.75	3.53	2.02*	1.50	3.73	2.49*	.44
4 x 4	3.11	7.36	2.37*	2.67	5.25	1.97*	.13
6 x 6	6.75	20.92	3.10*	11.50	81.67	7.10*	.88

0-0	0-0	0-0	0-0	0-0	0-0	0-1	0-0	0-0	0-0	0-0	0-0
0-0	0-0	0-0	0-0	1-0	0-0	0-0	0-0	0-0	1-0	2-0	0-0
0-0	0-0	0-0	1-0	0-0	0-0	1-0	1-0	0-0	0-0	0-0	0-0
0-0	0-0	0-0	0-0	0-1	0-0	0-0	0-0	0-0	0-0	0-0	0-0
0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
0-0	0-0	0-0	0-1	0-0	0-1	0-0	0-0	0-0	0-0	0-0	0-1
0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	1-0	0-0	0-0
1-0	1-1	0-0	0-0	1-2	0-0	0-0	0-0	0-0	1-0	0-0	0-0
0-0	0-0	1-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0
0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0	0-0

DATA RECOVERY AT SITES 31CH29 & 31CH8
B. EVERETT JORDAN DAM & LAKE
CHATHAM COUNTY, NORTH CAROLINA
COMMONWEALTH ASSOCIATES, INC.

FIGURE 12.1
CURATED TOOLS-
EXPEDIENT TOOLS
LAMELLA 16, BLOCK A



DATA RECOVERY AT SITES 31CH29 & 31CH8
B. EVERETT JORDAN DAM & LAKE
CHATHAM COUNTY, NORTH CAROLINA
COMMONWEALTH ASSOCIATES, INC.

FIGURE 12.2
TOTAL ARTIFACT & FEATURE DISTRIBUTION
LAMELLA 15, BLOCK A

This occupation forms somewhat of a contrast with lamella 16 for only at the 2 x 2 m grid size do the tool distributions appear random. In other words, it is not likely that all areas of the site had an equal chance of receiving a discarded tool. Clustering is apparent at the 1 x 1 m scale, more apparent at the 3 x 3 m scale, ambiguously at the 4 x 4 m scale, and strongly at the 6 x 6 m scale. At no scale, however, are the tool categories associated such that the value of r is sufficiently high to have a probability of less than .05 of occurring by chance.

Reference to Figure 12.2 will help with the numerical interpretation of these results. The SYMAP plot makes it apparent that several marked clusters of several tools each do occur and that they are small, and, moreover, at the 1 x 1 m scale. Further, it is clear that these small clusters often occur in proximity as to produce the indicated clustering at the 3 x 3 m scale, and that this is in turn most marked in the southern half of the block, producing the strong clustering at the 6 x 6 m scale.

Returning to the 1 x 1 m scale and examining the raw data it is apparent that the clusters are each composed of small numbers of tools and are usually either expedient tools or curated tools and only rarely contain both. For example, two small groups are shown in EU 10; one is comprised entirely of expedient tools, one entirely of curated tools. This occurs repeatedly across the block and clearly provides a numerical explanation of the low correlations. The presence of additional tools of the same class in adjacent squares clearly produces the clustering seen at the 3 x 3 m scale and occurrence of the majority of these units in the southern half of the block produces the 6 x 6 m clusters.

Overall, the Palmer I occupation reflects some differential use of on-site space, but, like lamella 16, such differentiation is at a small scale. There is some suggestion that the presence of more than one tool in a 1 x 1 m square is likely to imply the presence of a tool of the same class in an adjacent square (this could, in fact be tested using techniques for examining spatial autocorrelation [see Dacey 1973:325-328 or Hodder and Orton 1976: 174-183]) meaning that associated tool sets occur at greater than a 1 x 1 m scale, but no larger than a 3 x 3 in scale. The low correlations suggest that these small sets of tools are most likely to be comprised of tools of the same major class (i.e., either curated or expedient), but that clusters of each class are distributed across the site.

Lamellae 14/13 – Palmer II – A total of 80 tools were entered in the spatial analysis of the Palmer II occupation floor. This total included 31 curated tools and 49 expedient tools, a curated tool/expedient tool ratio of .63:1. The statistics of the distribution of these tools were calculated as:

Grid	curated tools			expedient tools			
Size	m	v	v/m	m	v	m	r
1 x 1	.22	.28	1.31*	.34	.41	1.20	.28*
2 x 2	.86	1.04	1.20	1.36	3.21	2.36*	.58*
3 x 3	1.94	2.72	1.41	3.06	6.20	2.02*	.58*
4 x 4	3.44	3.28	.95	5.44	17.03	3.13*	.36
6 x 6	7.75	10.91	1.41	12.25	28.25	2.31	.19

The structure evident on this occupation floor is rather different than the Palmer I floor. First is the fact that there are more expedient tools than curated tools, but second is the distinctly different form of distribution of these tool categories. Curated tools show a non-random distribution only at the 1 x 1 m scale, expedient tools are clustered at the 2 x 2, 3 x 3, and 4 x 4 scales (although the nv/m ratio for the 1 x 1 m is as close as possible to .05 without rejecting the random hypothesis; its apparently significant value reflects loss of information through rounding).

Space is differentiated, but not relative to curated tools except for one square in which two endscrapers and two bifaces were found. Otherwise, any square, at any scale, was just as likely as another to receive a curated tool. This is not the case with expedient tools, however. An expedient tool was more likely than chance to be found in a square adjacent to one in which another expedient tool was found. Examination of Figure 12.3 suggests that the observed clustering at the 2 x 2, 3 x 3, and 4 x 4 m scales results from the scattering of a few tools in each of adjacent squares through the southern and western parts of the block. This may not necessarily represent any more strongly organized use of space than do the Palmer I remains in lamella 15, however. The large number of expedient tools would suggest casual use of the surface and diffuse nature of the scatter of these tools may result from two or more repeated occupations with only partially overlapping areas of discard. The values of the correlations suggest that even though curated tools as a class appear to be largely randomly distributed, it may actually be somewhat more likely than pure chance that they will have been found with expedient tools.

Lamella 12/11 – Palmer III – The Palmer III occupation defined in lamella 12/11 had a slightly larger number of tools with provenience data used in the spatial analysis. A total of 103 tools, including 47 curated tools and 56 expedient tools were used in the analysis. The curated tool/expedient tool ratio is thus .84:1. The statistics of the distributions were computed as:

Grid	curated tools			expedient tools			
Size	m	v	v/m	m	v	v/m	r
1 x 1	.33	.39	1.19	.39	.71	1.84*	.34*
2 x 2	1.31	1.65	1.26	1.56	3.34	2.15*	.45*
3 x 3	2.94	7.66	2.61*	3.50	15.20	4.34*	.73*
4 x 4	5.22	13.94	2.67*	6.22	28.69	4.61*	.91*
6 x 6	11.75	30.92	2.63*	14.00	184.67	13.19*	.99*

Curated tools appear to have non-random distributions only at grid sizes of 3 x 3, 4 x 4, and 6 x 6 m, while expedient tools appear clustered at each scale studied. Unlike the Palmer I and II floors, however, curated and expedient tools show a moderate to strong spatial congruence, as evidenced by the high correlations between classes. Further interpretation of these numbers is assisted by reference to Figure 12.4.

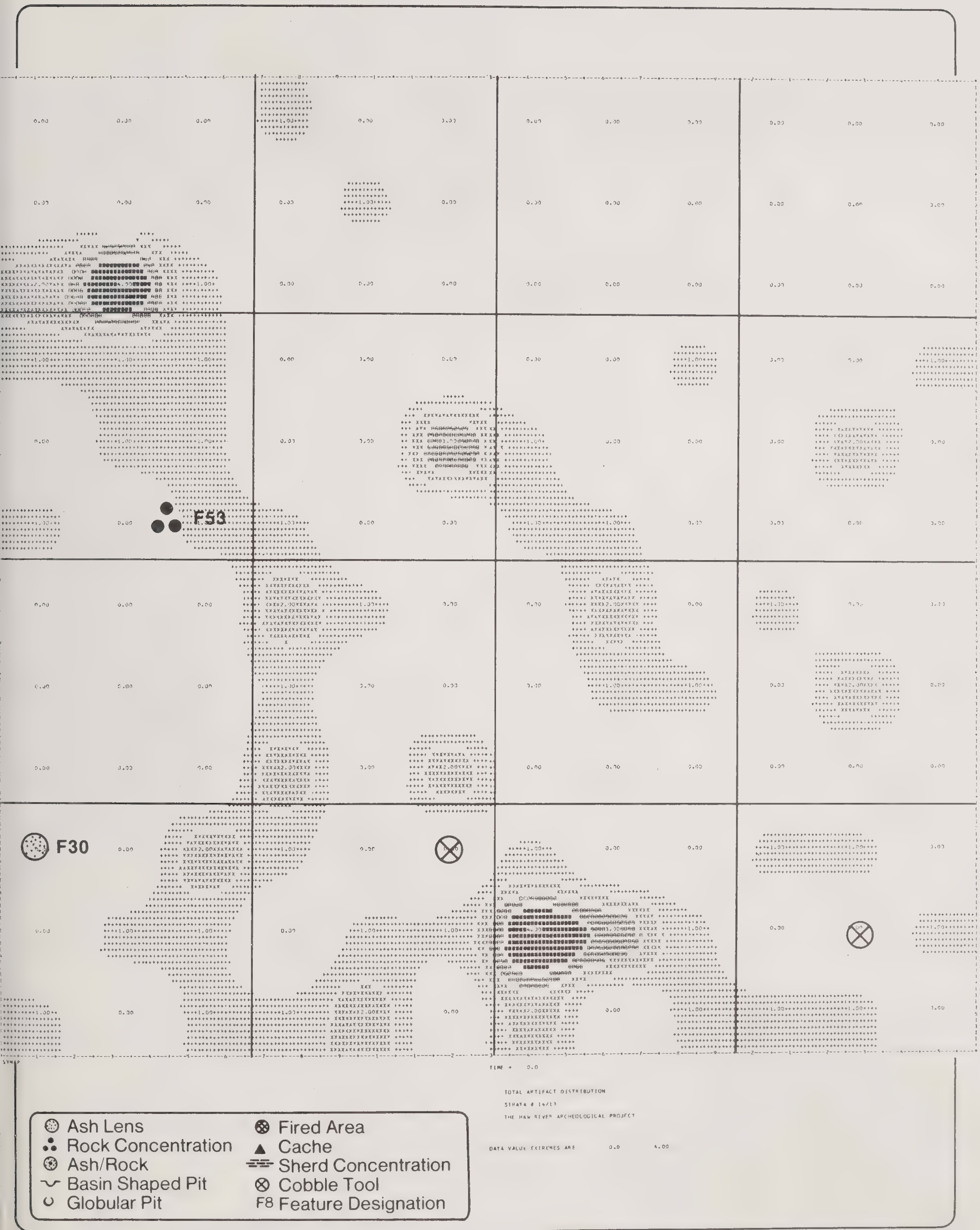


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FIGURE 12.3
TOTAL ARTIFACT & FEATURE DISTRIBUTION
LAMELLAE 14/13, BLOCK A

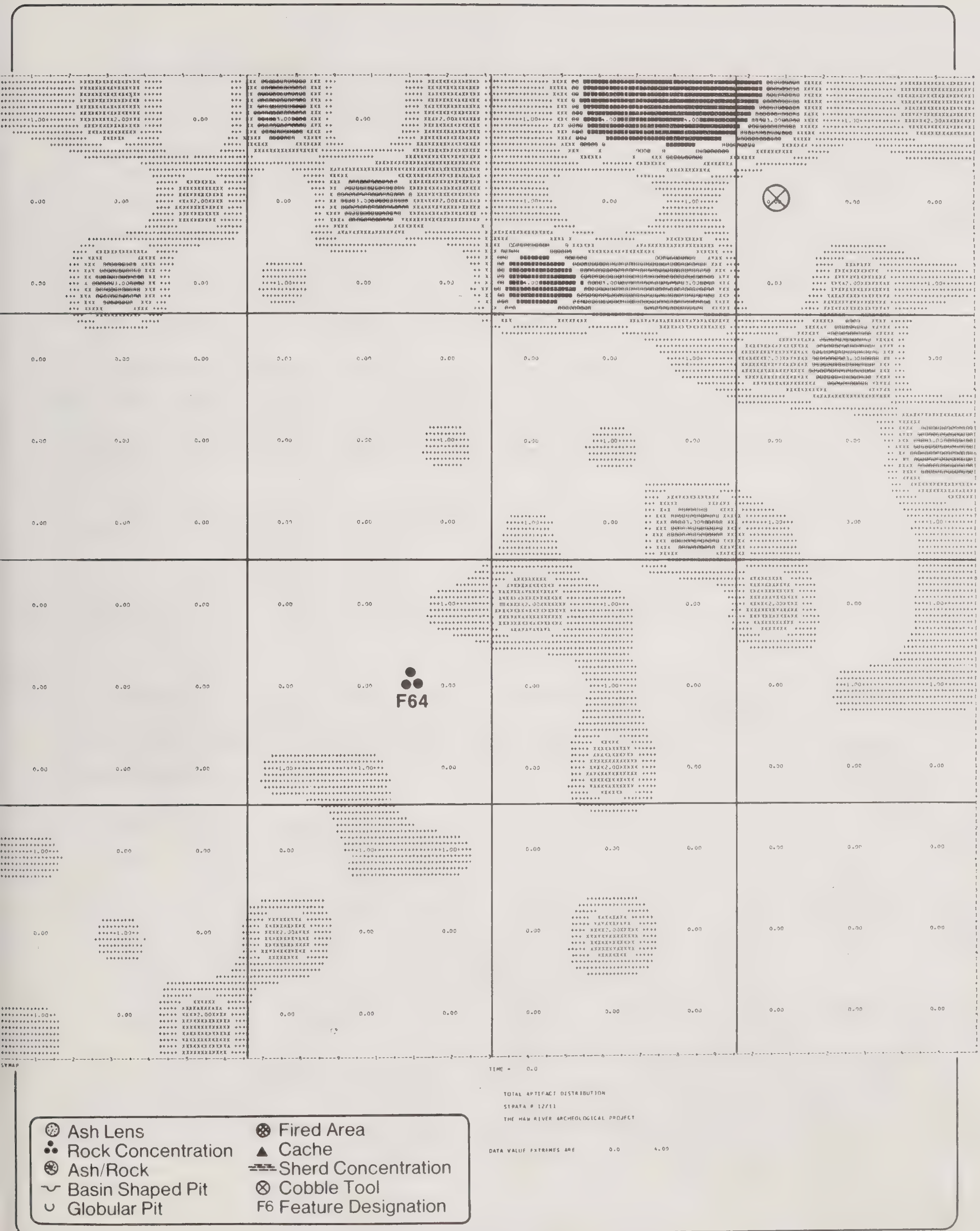

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FIGURE 12.4
TOTAL ARTIFACT &
FEATURE DISTRIBUTION
LAMELLAE 12/11, BLOCK A

Small groups of only two or three tools each are scattered across the southern three-quarters of the block. These groups may include several expedient tools, or both curated and expedient, but only rarely several curated tools, as evidenced by both the raw data and the non-random distribution of expedient tools (but *not* curated) at the 1 x 1 and 2 x 2 m scale. These small groups are, however, not randomly distributed through the block, but rather are in sufficient proximity to one another in parts of it so as to produce an apparent clustered distribution of tools at a larger scale. This structure is very similar to that in evidence on the Palmer I and II floors. The major difference between these two and the Palmer III floor is the greater degree of spatial congruence between curated and expedient tools on the Palmer III floor than on the Palmer I and II floors.

The northern quarter of the block shows several strong clusters of tools with continuous lighter scatter in between, a structure unlike that in any previously described occupation floor. Unfortunately there is the appearance that this concentration of tools extends into the unexcavated portion of the site north of the block, rendering interpretation difficult.

Overall, this occupation floor reflects some differentiation in use of on-site space, but a very similar form to that seen in the first two Palmer occupations. The northern edge of the block may reflect a different form of organization that is imperfectly glimpsed, or it may simply result from partially overlapping repeated minor occupations. In either event, associations between curated and expedient tools are overall somewhat stronger here than on any previous floor at 31Ch29.

Lamella 8 – Kirk I/St. Albans – The tool assemblage from this lamella was comprised of 164 items: 84 curated tools and 80 expedient tools, for a curated tool/expedient tool ratio of 1.05:1. Means, variances, variance/mean ratios, and correlations for these tool classes were computed as:

Grid	curated tools			expedient tools			
Size	m	v	v/m	m	v	v/m	r
1 x 1	.58	.92	1.57*	.56	.56	1.00	.26*
2 x 2	2.33	6.69	2.87*	2.22	3.72	1.67*	.60*
3 x 3	5.25	26.67	5.27*	5.00	14.27	2.85*	.64*
4 x 4	9.33	56.75	6.08*	8.89	30.61	3.44*	.81*
6 x 6	21.00	226.00	10.76*	20.00	206.67	10.33*	.96*

In this level, it is the curated tools that appear to have a non-random distribution at all scales of analysis, while the expedient tools are clustered at scales above 1 x 1 m. Correlations between curated and expedient tools are also strong at each scale.

Artifacts were definitely differentially discarded across the space intersected by the excavated block. The most noticeable difference (Figure 12.5) is the intense concentration of tools in the northwest quadrant of the block. Tool frequencies in this quadrant are, in fact, from nearly two to over five times as high as frequencies in adjacent quadrants. As with the preceeding lamella, it seems apparent that the excavation may have intersected only a part of a major concentration of artifacts. This major concentration, that is composed of both curated and expedient tools, obviously explains the highly clustered nature of the distribution when viewed at the 6 x 6 m, and probably 4 x 4 m, scale.

At a smaller scale, there are small groups of a few tools each usually near the main concentration in the northwest part of the block. These groups may contain either expedient tools, or curated tools, or some of each.

Overall, the spatial arrangement evidenced in lamella 8 reflects a more organized use of space then do previous lamella. The excavation block in its northwest quadrant may have intersected a strongly expressed living floor that is manifested as reasonably intense scatters of both curated and expedient tools. Groups containing fewer tools each are scattered beyond the major occupation area.

Lamella 7/6 — LeCroy/Kirk I and II/Stanly — This pair of lamellae contained by far the largest number of artifacts. A total of 323 artifacts were entered in the analysis. This total includes 146 curated tools and 177 expedient tools, the two groups being present in a curated tool/expedient tool ratio of .8:1. The statistics of the distributions of tools were calculated as:

Grid	curated tools			expedient tools			
Size	m	v	v/m	m	v	v/m	r
1 x 1	1.01	1.24	1.23*	1.22	2.16	1.77*	.09
2 x 2	4.06	6.17	1.52*	4.89	11.13	2.28*	.06
3 x 3	9.13	15.45	1.69*	11.00	39.47	3.59*	.07
4 x 4	16.22	31.94	1.97*	19.56	144.78	7.40*	.24
6 x 6	36.50	27.00	.74	44.00	66.67	1.52	.00

Clustering is evident for both categories of tools at the scales of 1 x 1, 2 x 2, 3 x 3, and 4 x 4 m, but not at the scale of 6 x 6 m. The v/m values for the curated tools and the X^2 values associated with these ratios do have a probability of less than .05 of occurring by chance but are barely above the critical values for rejection of the null hypothesis of a random distribution. Expedient tools are, however, somewhat more strongly clustered. The distribution of all tools is mapped in Figure 12.6.

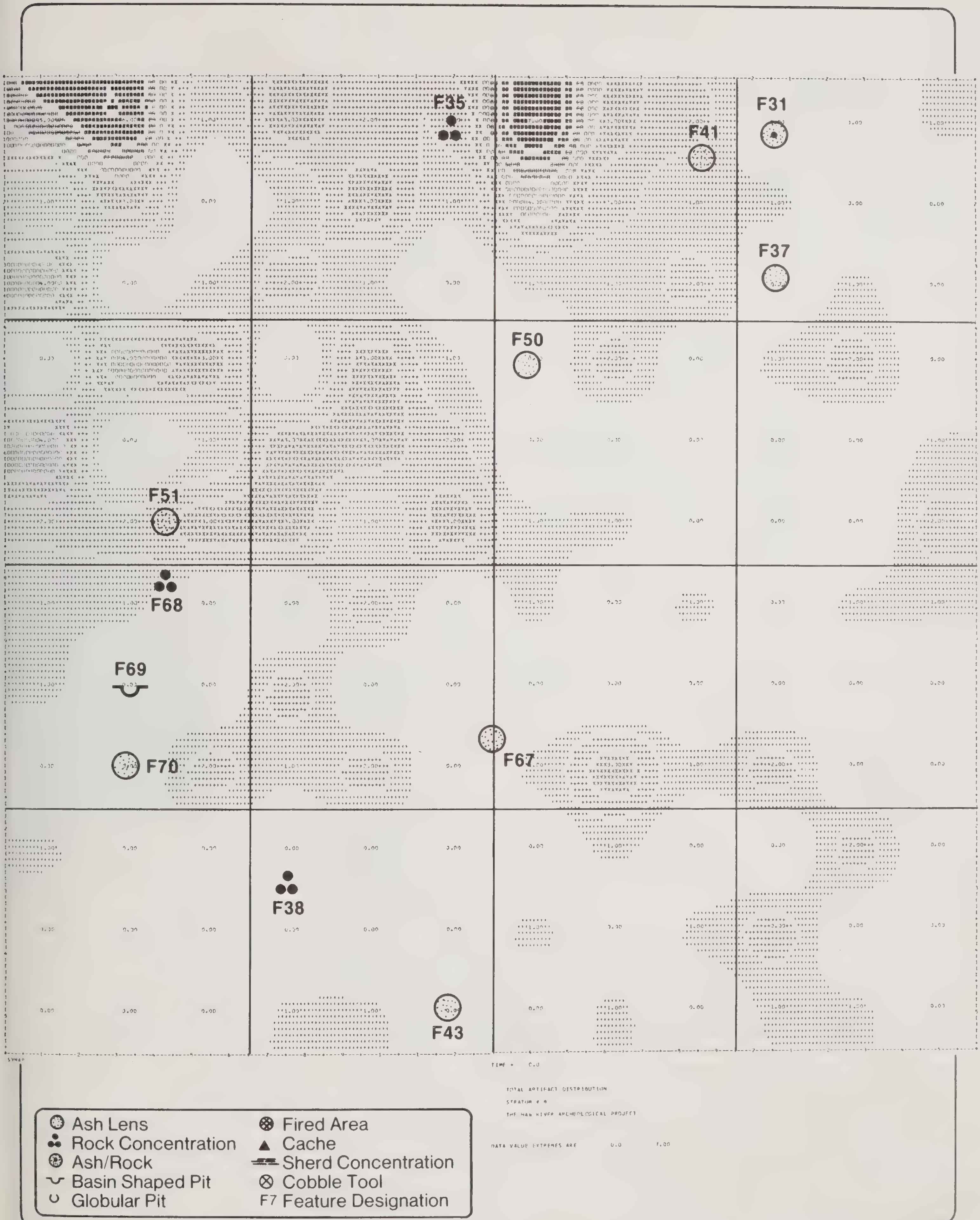

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FIGURE 12.5
TOTAL ARTIFACT & FEATURE DISTRIBUTION
LAMELLA 8, BLOCK A

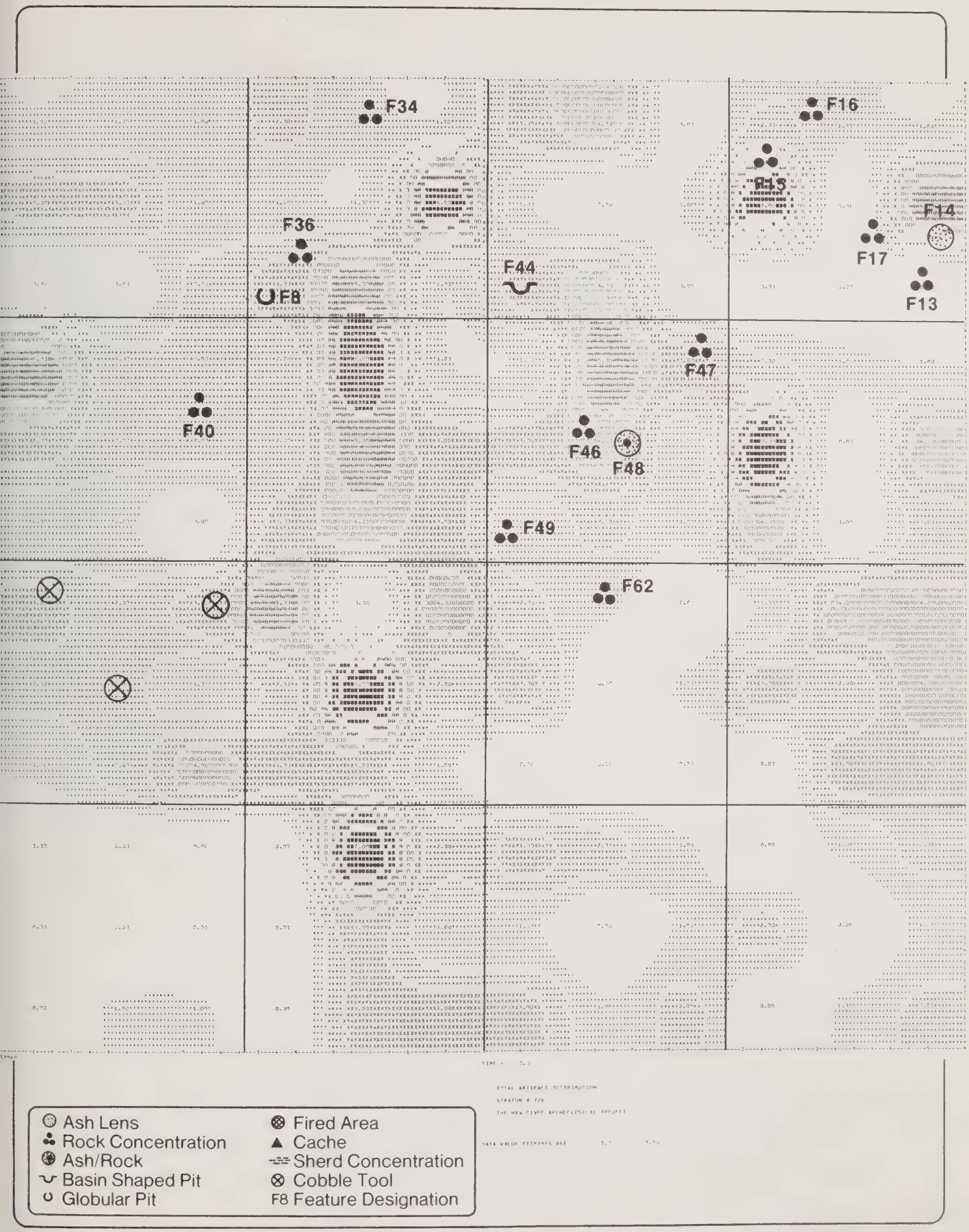

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FIGURE 12.6
TOTAL ARTIFACT & FEATURE DISTRIBUTION
LAMELLAE 7/6, BLOCK A

At least part of the reason for the far larger number of tools present in this level is the fact that, unlike previous lamellae, there are no large blank areas on the map; that is, tools are found throughout the block. This is undoubtedly the reason that they do not appear clustered at the 6 x 6 m scale.

Groups of tools, of various sizes and usually containing more expedient than curated tools, are distributed throughout the block and are generally surrounded by a background of smaller numbers of tools. Since fewer curated tools are contained in the more intense concentrations, their variance/mean ratios are lower. Note also that correlations between curated and expedient tools are very low at all scales, attaining a value of .00 at the 6 x 6 m scale (this value was double checked using both a computer and a calculator and it is, in fact, .00).

The interpretation of this distribution is highly confusing and it is likely that it is not at all reflective of a single occupation. While space is differentiated, it does not intuitively appear highly organized. Tools are not randomly scattered but the classes show very little spatial congruence.

Lamellae 5/4 – Stanly/Morrow Mountain – The number of tools recovered from this pair of lamellae is considerably lower than that included in the lamellae 7/6 analysis. A total of 147 tools were used. This total includes 73 curated tools and 74 expedient tools for a curated tool/expedient tool ratio of 1:1. The distribution of these tools is mapped in Figure 12.7. The means, variances, variance/mean ratios, and correlations for this distribution are:

Grid		curated tools			expedient tools		
Size	m	v	v/m	m	v	v/m	r
1 x 1	.51	.74	1.46*	.51	.81	1.58*	.17
2 x 2	2.03	3.11	1.54*	2.06	5.83	2.83*	.34
3 x 3	4.56	10.13	2.22*	4.63	25.32	5.47*	.32
4 x 4	8.11	11.61	1.43	8.44	38.78	4.59*	.34
6 x 6	18.25	58.92	3.23*	18.50	123.67	6.68*	.61

Clustering is indicated for both tool classes at all scales of analysis except the curated tools at the 4 x 4 m scale. Correlations between tool classes are low, however, and, in fact, never attain a sufficiently high level as to have a probability of $\leq$ .05 of occurring by chance.

Tools on this floor are densest in the southwest quadrant of the square, producing the indicated clustering at the 6 x 6 m square scale. Within the major area of scatter are smaller clusters of tools, apparently producing the indicated clustering at the 1 x 1, 2 x 2, and 3 x 3 m scales. Smaller groups of tools in lower densities are detached from the major

scatter in the southwest quadrant and occur virtually throughout the floor. These groups are likely to contain more expedient than curated tools. Features defined in this stratum are usually associated with tool clusters.

Overall, space is differentiated on this floor and the use of space may represent some degree of organization. Tool categories do not show strong correlations with one another but there is a visually marked congruence between the distribution of tools and the distribution of features.

Lamella 3 – Morrow Mountain – Data are available for only ten of 16 excavation units (90 squares) in this lamella. Nevertheless, a total of 149 tools were entered into the analysis. This total includes 94 curated tools and 55 expedient tools, a curated tool: expedient tool ratio of 1.7:1. This ratio is the highest at anytime during the Archaic occupations of 31Ch29 and could be a product of either drastically changing site function or a change in the degree of curation really afforded "curated tools."

Since overburden was removed with a backhoe, this lamella was not intact across the block (Figure 12.8). Nevertheless, data were available for 90 contiguous excavation units. Statistics of the distribution of tools in these units were computed as:

Grid	curated tools			expedient tools			
Size	m	v	v/m	m	v	v/m	r
1 x 1	1.04	2.11	2.02*	.61	.98	1.61*	.17
2 x 2	4.10	18.29	4.47*	2.57	10.06	3.91*	.29
3 x 3	9.40	42.49	4.52*	5.50	30.72	5.59*	.25

Clearly there is a moderately strong clustering of tools at all scales of analysis. This clustering includes both curated and expedient tools, but these two classes do not, in fact, show a high degree of spatial congruence.

A reasonably dense group of tools, particularly curated tools, is seen near the southwest corner of the block. This group encompasses several contiguous squares and undoubtedly is an important reason for the apparent clustering at all scales of analysis. Smaller, less intense groups of tools are detached from this cluster and are spread across the block. A small group of largely expedient tools is present near the center of the block.

Overall, there is some differentiation of space on this floor. Tool categories show little congruence with one another, but yet each category is internally clustered.

The eight Archaic components defined at 31Ch29 thus clearly exhibit both similarities and differences. For example, curated tool/expedient tool ratios vary near 1:1 in all but lamella 3. The form of artifact clustering, including scale of clustering, strength of clustering, and strength of association between tool classes, however, varies considerably through

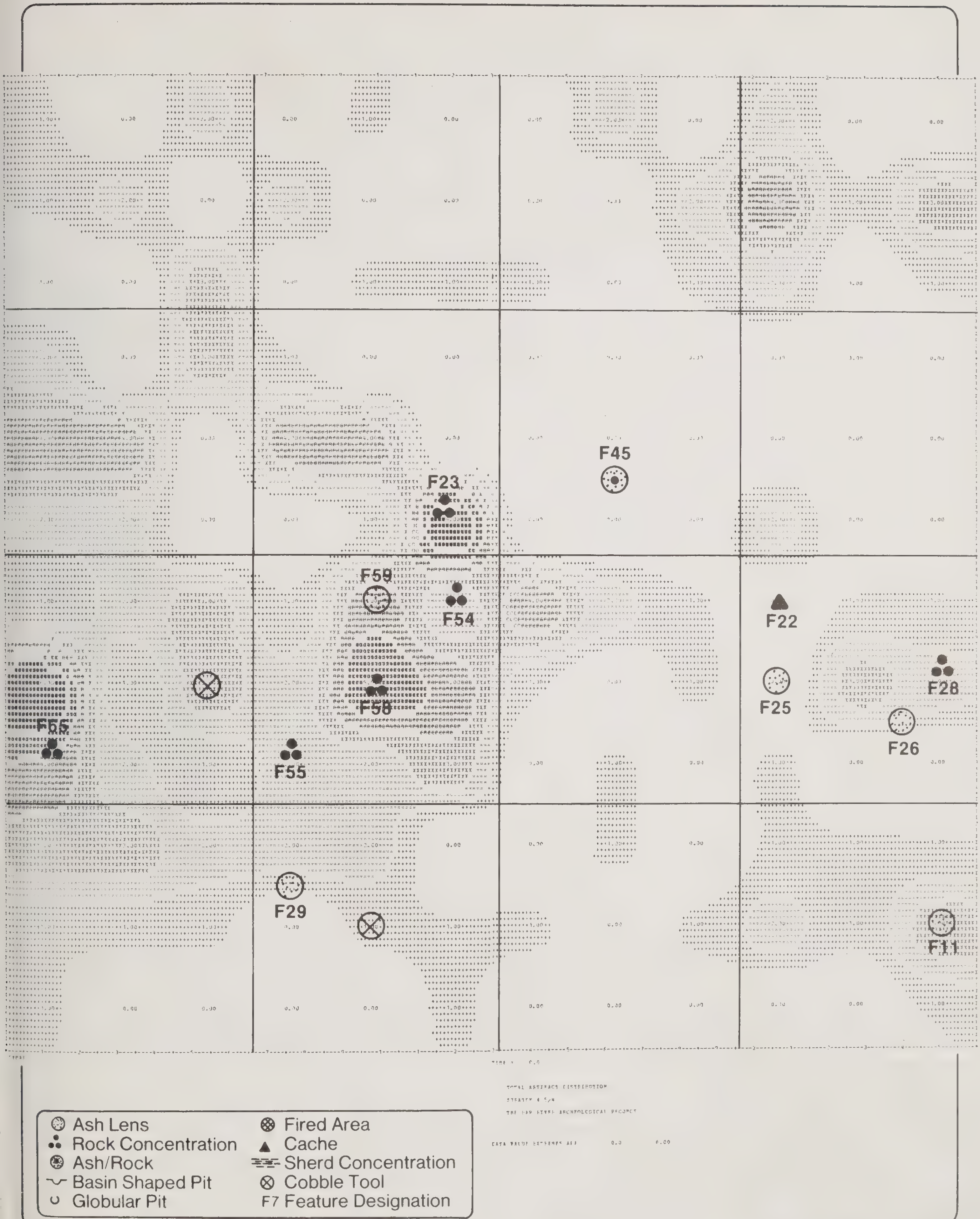

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FIGURE 12.7
TOTAL ARTIFACT & FEATURE DISTRIBUTION
LAMELLAE 5/4, BLOCK A

1-0	0-0	4-1	0-0	2-0	1-0						
2-0	2-0	1-1	1-0	5-0	0-1						
1-0	0-1	0-1	1-0	4-0	0-0						
1-1	1-1	1-0	0-0	0-0	0-0	0-5	3-5	1-2	0-0	0-0	1-0
6-0	1-0	0-0	0-0	0-0	0-0	0-1	0-3	1-0	1-0	0-1	0-0
3-2	5-0	0-0	0-0	0-0	0-0	1-0	0-0	0-2	1-0	3-2	2-1
4-2	7-2	2-0	0-0	1-0	1-1	0-0	0-1	0-0	0-1	1-1	1-0
1-0	2-2	0-1	2-0	2-0	0-1	0-0	0-0	0-0	3-1	1-1	0-0
2-2	0-2	1-1	0-2	1-0	1-1	0-0	0-0	0-0	1-0	2-1	1-1

FIGURE 12.8
CURATED TOOLS-
EXPEDIENT TOOLS
LAMELLA 3, BLOCK A

the sequence. An interpretation will be offered, but first, examination of spatial organization throughout, the sequence of human habitation on the Haw River floodplain will be completed by parallel analyses of spatial organization manifested at occupations defined at 31Ch8. We do this, however, in two parts. The second part is the exact counterpart of the 31Ch29 analysis. However, an additional artifact class is present in the 31Ch8 assemblages; that artifact class, of course, is ceramics. Inclusion of ceramics with tools, however, presents something of a problem, for tools functioned as individual entities, while pottery is almost always presented to the archeologist as a bunch of sherds, not as the contextually equivalent entity of a vessel. Prior to the analysis of complete assemblages from 31Ch8, therefore, a separate detailed analysis of ceramic disposal is presented.

SPATIAL ANALYSIS OF CERAMIC ARTIFACT DATA FROM 31Ch8

> For many years pottery has been recognized as a cornerstone upon which archeological cultural complexes may be built. The pottery type has formed the basis for cultural identification and has become a measure of temporal development. The use of pottery for this purpose has succeeded so well that other items in the cultural inventories have tended to become mere ribbons with which to dress up the final report (Coe 1964:8).

The use of pottery for this purpose has also succeeded so well that it was long used for little else but cultural identification and temporal measurement. Beginning in the 1960s, however, two trends were to emerge in archeology, the coalescence of which is the topic of this section. The first of these was emergence of the concept that ceramics, and indeed all archeological materials, reflected far more than temporal and general cultural connections. Studies such as those by Deetz (1965), Longacre (1970) and Hill (1970) translated this notion into action by treating ceramic designs as reflective of kinship and social organization in prehistoric societies. While these analyses were generally considered to be overly enthusiastic and were subsequently shown to be based on some unsupported assumptions (Allen and Richardson 1971) they nevertheless set the precedent for investigation of problems beyond chronology. Ceramic analysis has since been pursued along several lines of inquiry (see Plog 1980:1-4 for a brief but comprehensive review).

The other product of the 1960's of importance here was the archeological study of the activity structure of prehistoric sites. Binford and Binford's (1966) classic study of functional variability in Mousterian occupations perhaps provided the major impetus for this type of analysis and was soon followed by a variety of other studies. As with the social organization studies, such analyses were at first somewhat naive, being built on assumptions about relations between behavior and its material consequences that have not yet been adequately demonstrated. For example, while Longacre and Ayres (1968) claimed success in the reconstruction of activities at an abandoned Apache wickiup, Bonnichsen (1973) found himself considerably less successful in inferring the activity structure of Millie's camp. Studies by Ascher (1968) and Lange and Rydberg (1972) of deterioration processes in abandoned houses revealed some of the archeological processes that occur at such sites.

Beyond this, however, it was realized that materials were input to archeological context at different rates, that they were not necessarily discarded at the locus of use and that what happened to this material subsequent to its discard (reuse, redeposition, comminution) was an important modifier of the relation between locus of use and locus of final discard (Schiffer 1972). Just as ethnoarcheological studies of ceramic manufacture and decoration seek to understand the basis for and limitations on the inference of social organization from ceramic design, so also do another set of ethnoarcheological studies seek to understand how the archeological record is formed.

This section of the Haw River analysis seeks to examine the distribution of ceramics in the Block C excavation at 31Ch8, applying techniques of spatial analysis to this single debris class. A study of this type could conceivably be done in one of several ways, depending upon our knowledge of ceramic deposition in general and North Carolina Piedmont Woodland ceramic disposal patterns in specific. Unfortunately, only a few studies make even general remarks about ceramic disposal patterns and some very general remarks by Newkirk (1978:58-59) comprise the entire body of evidence for Woodland ceramic disposal patterns in the North Carolina Piedmont. In the absence of other useful data, therefore, the present analysis is conceived largely as a study in ceramic disposal patterns and comminution processes. It is undertaken for the twin purposes of seeking to interpret the structure of archeological deposits at 31Ch8 and of understanding how ceramics are discarded.

Ceramics in the Formation of Archeological Middens

The ceramic element of the archeological record and its distribution is conditioned by three factors: 1) the input to the archeological record — that is, the rates at which pottery vessels break and the factors contributing to the differential rates of input to archeological context of various kinds of vessel groups, 2) patterns and habits of refuse discard, and 3) post-depositional disturbance processes. Each of these is, in turn, determined by a number of considerations.

Ceramic longevity has been studied ethnographically by Foster (1960), David (1972), DeBoer (1974), and others (see Stanislawski 1978:223-224 for discussion of several other studies). In each of these the observer grouped ceramic vessels into series of functional and size groups and calculated the median life expectancy of each form. In every case, it was found that broken vessels had different median life expectancies and consequently entered the archeological record at different rates. Small, frequently used vessels not surprisingly have the shortest life expectancy — these vessels were moved from place to place most often and subjected to mishandling, carelessness, slippage, etc. Foster (1960:356-357) enumerated five factors affecting the life expectancy of a ceramic vessel: 1) basic strength, 2) pottery use — by which he meant frequency of use and amount of movement involved in using the vessel, 3) mode of use — how cooking is done, 4) causes of breakage — particularly whether animals are present or absent, and, more tentatively, 5) pottery costs — thus affecting, he suggested, how much care was taken in handling pots. The first two of these factors are likely to be the more important in the North Carolina Piedmont during Woodland times.

The phrase "patterns and habits of refuse discard" refers to where trash is discarded and what is discarded. Pottery does not necessarily become midden fill upon breakage. David and Hennig (1972:21) report that among the Fulani

> Broken pottery is occasionally useful; large sherds serve to feed grain to sheep and goats, smaller pieces in pottery manufacture. Cracked pots are used for cooking tripods.

Stanislawski (1969) reports an even wider range of reuses of broken pottery among the Hopi and Hopi-Tewa. He reports three classes of use of potsherds by the Hopi and Hopi-Tewa of the First Mesa in Arizona: 1) use in the manufacture of other pottery — including use of sherds for covering newly made pots during firing so that the fuel does not touch them and cause discoloration, use for tempering material, and as design templates, 2) chinking in window or door frames or in the walls for bread ovens, and 3) ceremonial uses (Stanislawksi 1969:12-16).

While the majority of broken ceramics are discarded, actual location of discard is of considerable importance to the interpretation of the archeological record. DeBoer and Lathrap (1979:129) have stated one expectable pattern of refuse distribution:

> . . . within a sedentary community, primary refuse, where sites of use and discard coincide, is probably ephemeral, and midden accumulates exactly where behavior is minimal

and have exemplified it at the site of San Francisco de Yarinacocha in the Ucayali Basin of Peru. The maps of refuse distribution show that

> . . . the house areas and plaza are virtually barren of refuse; . . . secondary refuse accumulates among the trees which mark the western border of the plaza and along the fence which marks the eastern border (DeBoer and Lathrap 1979:129).

David and Hennig (1972:21) similarly report that most pottery is simply discarded along the compound fence, either inside or outside. Similar descriptions appear in other ethnographic descriptions (e.g., Bonnichsen 1973, Lange and Rydberg 1972).

How the archeologist observes archeological remains — that is, the form in which they present themselves to the archeologist — is further conditioned not only by where refuse is disposed but also by what forces act on it subsequent to deposition. Two classes of things can happen to discarded trash. First, and probably less frequently, it can be scavenged and thus returned to systemic context, processes that Schiffer refers to as A-S processes, or archeological context to systemic context processes (Schiffer 1976:34-36). The Hopi and Hopi-Tewa case is a good example, for Stanislawski describes the extensive use of *prehistoric* ceramic sherds for wall and door frame chinking in particular.

The second class of processes operative on discarded material are more destructive in nature (A-A processes in Schiffer's [1976:36-37] parlance). David and Hennig (1972: 21) found among the Fulani that

> as the area is cultivated, it [the ceramic trash] is redistributed and comminuted into smaller and smaller sherds. The fields in the village are liberally strewn with sherds of the Fulani and previous occupations.

DeBoer and Lathrap (1979:133) report that

> sherds which occur along the path leading from the houses to the ceramic shed tend to be smaller in size than sherds in secondary refuse resulting from centrifugal sweeping. This latter fact is readily attributable to sherd comminution by people walking along the path.

They present a graphic comparison of size distributions in the two areas to demonstrate this point.

Beyond these processes, construction, plowing, bulldozing, or any of a variety of other factors may accelerate destruction of discarded ceramics and seriously alter their primary spatial contexts.

Accurate interpretation of ceramic distributions is therefore far from straightforward. As seen in this brief survey of the literature, the content and distribution of ceramics is conditioned by a variety of factors. Pots do not break at similar rates. We would expect that more frequently used and more portable vessels would have a shorter life expectancy, thus entering archeological context at a faster rate; we likewise would expect vessels with a less strong construction to also enter archeological context at a faster rate.

Not all sherds from broken pots can be expected to immediately enter archeological context. Some sherds, particularly the larger specimens, may be recycled for any of a wide variety of uses. Others may be ground up and used as tempering material in future ceramic manufacture. Many vessels will be discarded — usually as secondary refuse (that is, trash discarded away from its locus of use), often at the edge of a habitation area. However, disposal away from a habitation area does not necessarily ensure that disposal practices will be frozen in the archeological record. Scavenging, and perhaps other forces may lead to removal of sherds from the disposal site; plowing, trampling, leaching of tempering material, and a host of other processes potentially can lead to further destruction and deterioration of ceramics, thus affecting what the archeologist observes. In light of these caveats, therefore, the remainder of this section is devoted to an examination of the content and distribution of the ceramics excavated from Block C at 31Ch8 and to an attempt to interpret the behavior associated with ceramic deposition at the site.

The Haw River Ceramic Sample

The ceramic collection from Block C contains 3649 sherds. Detailed typological and technological analyses of a sample of this corpus have been conducted by Alan Snavely and Paul Raber and are described elsewhere in this report. For the present analysis, where the emphasis is on spatial distribution, a limited number of descriptive attributes were coded, including horizontal and vertical provenience, temper (quartz, sand, feldspar, grit, and grog), and sherd size ($<$ ½", ½"-1", 1"-2", $\geq$ 2"). These data were not coded by this writer, therefore, for this analysis it is assumed that the data are correct and replicable.

Tables 12.1 through 12.3 summarize these basic descriptive data for the sherd sample. Clearly, although there is variability in the sherd collection, the vast majority are feldspar tempered and are small. Neither are sherds evenly distributed through the profile (Figure 12.9). Ceramics in general occur in larger numbers in the upper levels. A definite fall-off in ceramic frequency occurs below arbitrary level 4 and a second sharp decline occurs below level 6. Only 16 sherds (.4%) are found below level 9. One-hundred-seventy-four sherds (4.8%) are associated with a "pot-bust" feature identified in the field in EU 7. This feature began at level 4 and extended down into level 8. The sherds associated with this feature were coded by feature and not level and are therefore excluded from any analysis by levels (Fig. 12.9).

Figure 12.10 shows the distribution of temper types within each level, exclusive of those sherds associated with the pot-bust feature. Feldspar, which is present in 70.5 percent of the 3475 sherds, is always the predominant temper. This is also true of the sherds associated with the pot-bust feature, 173 (of 174 = 99.4%) of which are feldspar tempered. Quartz temper is most abundant in the upper level and steadily declines throughout the profile (the apparent increase in level 9 is due to the presence of a single sherd only). Sand temper, on the other hand, generally constitutes a greater percent of ceramics as depth increases. Grit and grog tempered sherds together account for only 135 (3.9%) of the total 3475 sherds. Grit temper occurs in minor proportions throughout the profile to level 7; the few grog-tempered sherds all are from the upper two levels.

Before these data are submitted to spatial analysis, it is important to examine associations among the sherd attributes. Of particular importance is the interaction of sherd temper and sherd size. A crosstabulation of temper and sherd size is given in Table 12.4 for all sherds except those eight for which either temper or size or both were not coded. The associated chi-square value of 259.8, with 12 degrees of freedom, has a probability of less than .001 of occurring by chance. Major departures from random occur in the vast overrepresentation of sherds of 1" or larger among sand-tempered sherds. Quartz and grit are also overrepresented in the class of sherds ½" or less.

TABLE 12.1
FREQUENCY DISTRIBUTIONS – SHERD ATTRIBUTES BY LEVEL

Arbritrary Level	Absolute Freq	Relative Freq (Pct)	Cum Freq (Pct)
1	1,068	29.3	29.3
2	562	15.4	44.7
3	655	18.0	62.6
4	620	17.0	79.6
5	309	8.5	88.1
6	127	3.5	91.6
7	69	1.9	93.5
8	25	0.7	94.1
9	24	0.7	94.8
10	12	0.3	95.1
11	3	0.1	95.2
12	1	0.0	95.2
45*	1	0.0	95.3
48*	173	4.7	100.0
TOTAL	3,469	100.0	

* "Levels" 45 and 48 refer to a ceramic feature that extended from Levels 4 through 8 and was excavated as a feature rather than by arbitrary level.

TABLE 12.2
FREQUENCY DISTRIBUTIONS – SHERD ATTRIBUTES BY TEMPER

Temper	Absolute Freq	Relative Freq (Pct)
Not recorded	5	0.1
Quartz	365	10.0
Sand	522	14.3
Feldspar	2622	71.9
Grit	123	3.4
Grog	12	0.3
TOTAL	3649	100.0

TABLE 12.3
FREQUENCY DISTRIBUTIONS – SHERD ATTRIBUTES BY SHERD SIZE

Category Label	Sherd Size	Absolute Freq	Relative Freq (Pct)	Adjusted Freq (Pct)	Cum Freq (Pct)
	Not recorded	6	0.2	0.2	0.2
	⟨ ½″	1321	36.2	36.2	36.4
	½″ – 1″	1792	49.1	49.1	85.5
	1″ – 2″	452	12.4	12.4	97.9
	⟩̲ 2″	78	2.1	2.1	100.0
	TOTAL	3649	100.0	100.0	

TABLE 12.4
SHERD SIZE AND TEMPER

Size	Quartz	Sand	Feldspar	Temper Grit	Grog	Total
⟨ ½″	106	118	1066	28	3	1321
½″ – 1″	230	224	1262	67	8	1791
1″ – 2″	29	157	240	24	1	451
⟩̲ 2″	0	23	51	4	0	78
TOTAL	365	522	2619	123	12	3641

$x^2=259.8$ df=12 $p<.001$

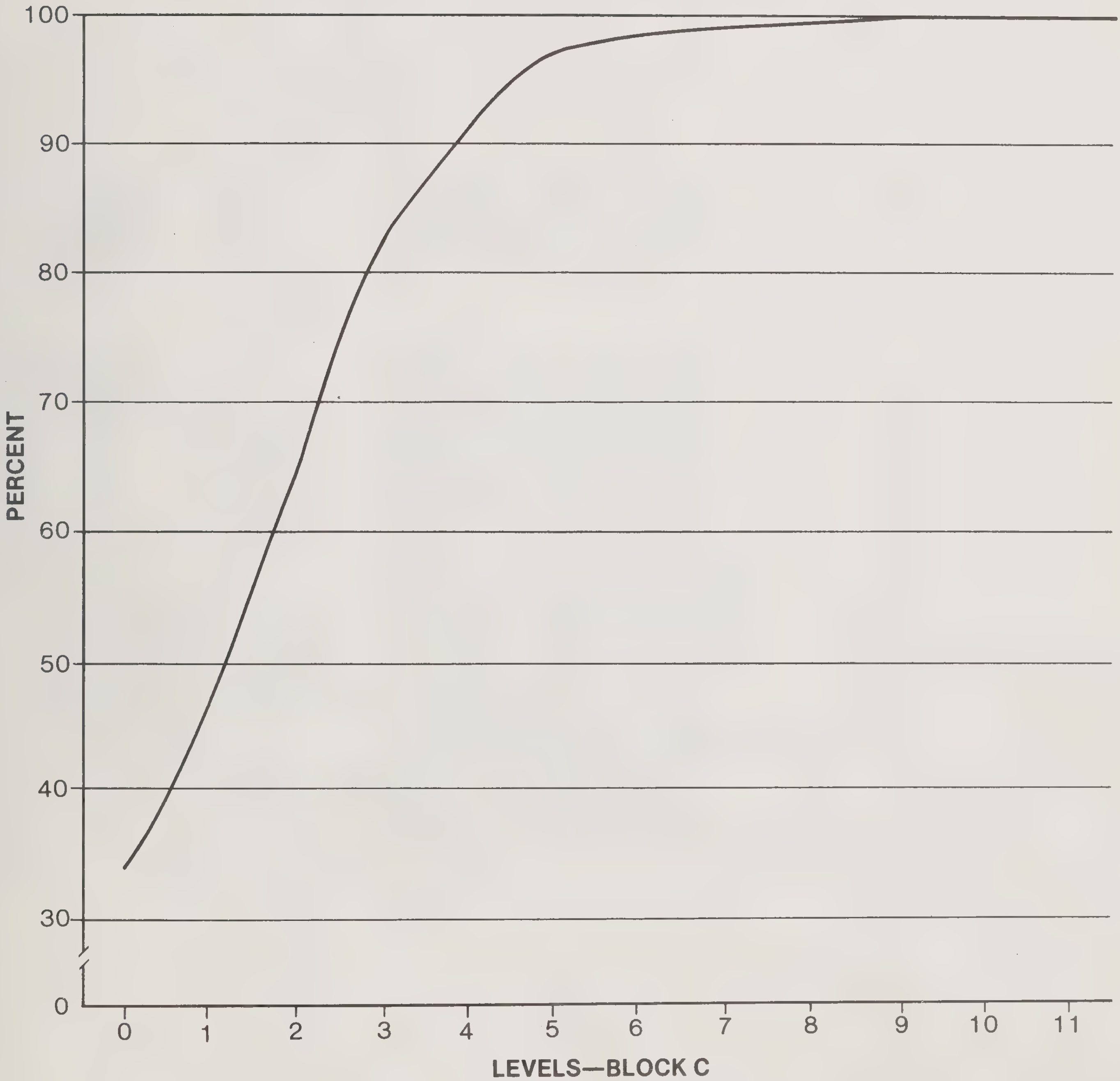

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FIGURE 12.9
CUMULATIVE FREQUENCY
DISTRIBUTION OF SHERDS
BY LEVEL

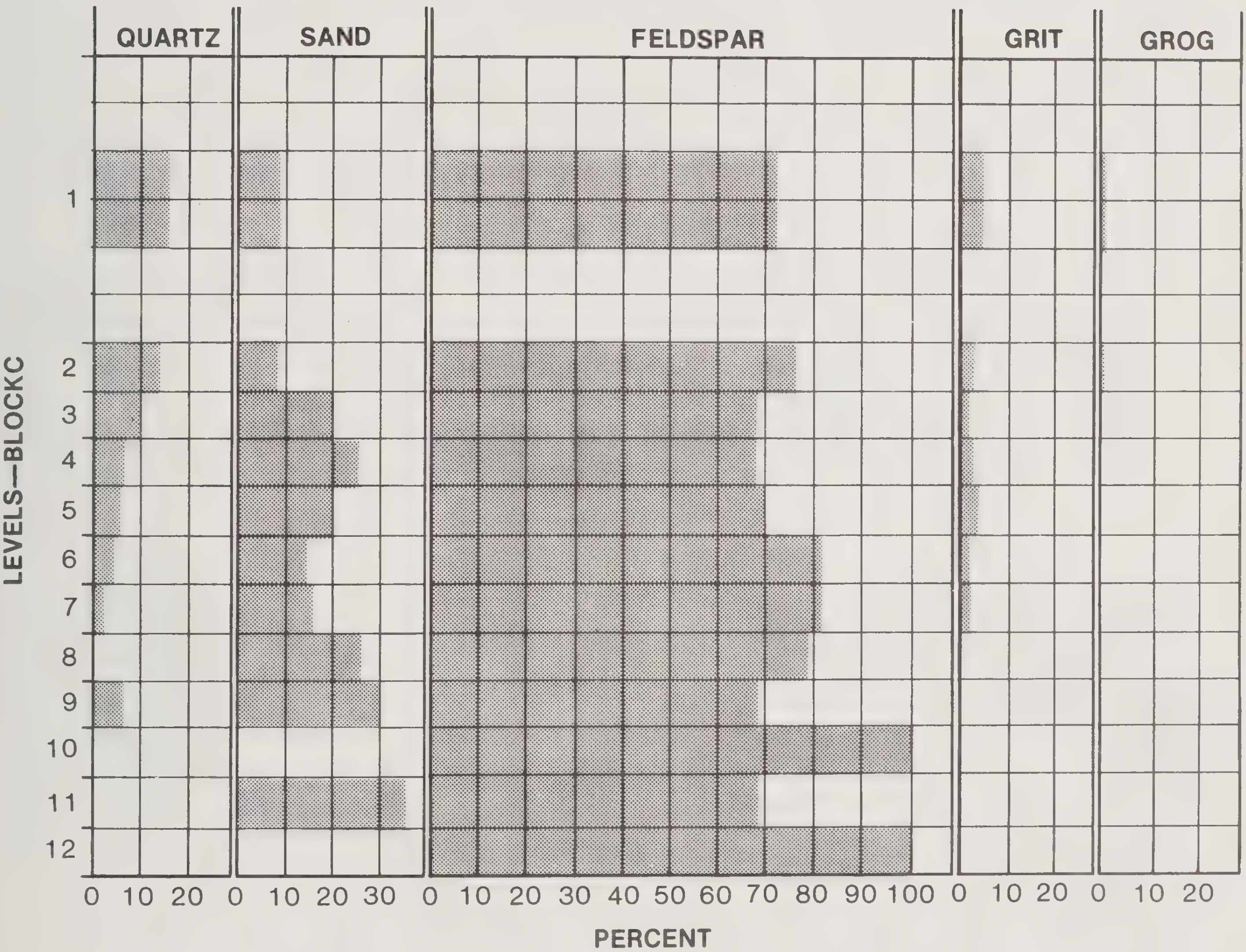

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FIGURE 12.10
TEMPER CATEGORIES
BY LEVEL

Several possible reasons may be adduced to account for this difference, and some evidence for or against them must be presented before spatial analysis is attempted. A very likely possibility is that major differences occur in vessel strength. Unfortunately, ceramic strength is a difficult property to measure; Shepard (1956:131) has listed multiple conditions influencing vessel strength, including: texture of the paste, particle size and composition of the clay, method of preparing the paste, technique of building the vessel, rate of drying, temperature and atmosphere of firing, and size and shape of the vessel. She also notes (Shepard 1956:131) that "texture, as conditioned by the amount, size, and shape of nonplastic inclusions [i.e., temper], is a primary cause of the variability in strength of low-fired pottery." One of the 31Ch8 ceramics coders noted that the feldspar tempered sherds were definitely more crumbly than sherds with any other kind of temper (J. A. Newkirk, personal communication).

This observation is in many ways consistent with the fact that there are many more feldspar tempered sherds than sherds with other kinds of temper in the 31Ch8 collection. If feldspar does produce a weaker-walled vessel, it would be expected that feldspar-tempered vessels will have a shorter life expectancy than those tempered with quartz, sand, grit, or grog. More rapid input of feldspar tempered vessels into site deposits, coupled with greater subsequent comminution of those vessel fragments, would indeed produce a numerical predominance of feldspar tempered sherds such as is seen in the ceramic sample from 31Ch8.

Still, other possible explanations must be considered for the observed differential breakage of variously tempered ceramics. Among these is a change in site function. If we expect temper types to show battleship curves of frequency through time, then we might expect to support or refute a proposition of differential site function by examining breakage by level for each temper type. If site function changes, this might be reflected in a differential distribution of sherd sizes among levels. Distributions are here analyzed for each temper type in order to avoid the effects of the interaction of temper type and level that has just been shown to exist. Chi-square tests of sherd size distributions by level are presented in Table 12.5. Neither quartz nor grog tempered ceramics have a sufficiently high chi-square value to allow rejection of the null hypothesis of a random distribution by level. However, the probability of the observed distribution of sherd size by level occurring by chance is about .01 for both feldspar and grit tempered ceramics and for sand tempered ceramics is less than .001, suggesting that we may wish to reject the null hypothesis of a random distribution for both groups.

A brief examination of the distribution of the chi-square values within each table will be informative. Cumulative chi-square values for each row within each table are shown in the last column of each part of Table 12.5. Major contributions to each table's overall chi-square can be summarized as follows for each temper category.

TABLE 12.5
SHERD SIZE CATEGORIES BY LEVEL FOR
TEMPER CATEGORIES

Quartz

Level	SHERD SIZE 1	2	3	Total	Row x^2
1	49	102	17	168	1.14
2	15	55	3	73	4.92
3	16	42	6	64	0.59
4	20	15	3	38	10.62
5	4	12	0	16	1.72
6	1	3	0	4	0.43
7	0	1	0	1	0.59
9	1	0	0	1	3.03
TOTAL	106	230	29	365	

x^2=22.47 DF=14 $p > .05$

Sand

Level	SHERD SIZE 1	2	3	4	Total	Row x^2
1	41	37	13	0	91	31.56
2	9	24	15	0	48	3.01
3	22	54	53	5	134	6.97
4	22	57	54	14	147	15.52
5	13	31	15	1	60	2.56
6	4	9	1	3	17	10.37
7	3	5	2	0	10	1.11
8	1	4	1	0	6	1.50
9	3	3	1	0	7	2.13
TOTAL	118	224	155	23	520	

x^2=74.72 df=24 $p < .001$

Feldspar

Level	SHERD SIZE 1	2	3	4	Total	Row x^2
1	337	388	32	3	760	4.31
2	169	227	17	3	416	4.44
3	189	218	26	1	434	1.06
4	188	196	24	4	412	2.00
5	98	95	21	2	216	7.89
6	38	52	11	2	103	8.10
7	25	27	3	0	55	0.43
8	4	11	4	0	19	10.06
9	6	7	3	0	16	4.94
10	6	5	1	0	12	0.51
11	0	7	1	0	8	6.32
12	1	0	0	0	1	1.31
TOTAL	1061	1233	143	15	2452	

x^2=51.34 df=33 p .01

Grit

Level	SHERD SIZE 1	2	3	4	Total	Row x^2
1	10	27	2	0	39	7.11
2	7	11	3	0	21	2.03
3	6	9	5	0	20	1.75
4	4	10	6	1	21	1.34
5	1	6	7	3	17	18.20
6	0	3	0	0	3	2.51
7	0	1	1	0	2	1.48
TOTAL	28	67	24	4	123	

x^2=34.70 df=18 p .01

Grog

Level	SHERD SIZE 1	2	3	4	Total	Row x^2
1	2	7	2	2	11	.18
2	1	1	1	1	3	.70
TOTAL	3	8	3	3	14	

x^2=.88 df=2 p 〉 .50

Quartz — Although the total chi-square was not sufficiently high to suggest rejection of the null hypothesis of a random distribution, the individual chi-square for level 4 is sufficiently high as to have a higher than expected by chance deviation from random. Examination of individual cell chi-square values (not given) shows that there are considerably fewer small sherds than might be expected by chance.

Sand — Levels 1, 4, and 6 each have high chi-square values. Examination of individual cell chi-squares shows that small sherds ($<$ ½") are highly overrepresented in level 1, large sherds (in the 1"-2" and $\geq$ 2") size classes are overrepresented in level 4, and sherds in the 2" and larger size class are overrepresented in level 6.

Feldspar — Levels 5, 6, and 8 each have high chi-square values. In each case there are more sherds in the 1"-2" size class than would be expected in a random distribution. In level 6, there are also more sherds of 2" or greater than would be expected by chance.

Grit — Levels 1 and 5 have high chi-square values. In level 1 the high value is a result of an underrepresentation of larger sherds 1" and greater and in level 6 is a result of a large overrepresentation of sherds of 1" or greater.

Grog — The overall chi-square for this table has a probability of greater than .50 of occurring by chance. No level or individual chi-square value is high by itself.

With the exception of quartz-tempered ceramics which run counter to the trend, and grog-tempered ceramics that are completely randomly distributed, the overall pattern that emerges is one of considerable breakage of sherds in the upper level in particular and an overrepresentation of larger sherds in levels 4 through 6 and occasionally deeper.

Level 1 shows excessive disturbance by clearing, plowing, and other recent activities. This fact in itself may well account for the generally smaller sherds occurring in this level. Nevertheless, the observation remains that levels 2 and 3 appear to have random distributions of sherd sizes while the deeper levels do not for all temper categories. This suggests a slightly changing configuration of disposal patterns of ceramics at different stages in the history of the site. This will be borne out by examination of spatial configurations within each level.

Spatial Analysis

The analysis of the 31Ch29 assemblages initially posed and tested the null hypothesis of a random distribution of tools. However, testing a null hypotheses of a random distribution is not always necessary appropriate.

Review of the ceramic disposal literature overwhelmingly suggests that a nonrandom and non-regular distribution of ceramic remains is normally to be expected. The examination of the literature on ceramic disposal would lead us to expect clusterings of *sherds* within archeological deposits. The studies by DeBoer and Lathrap and by David and Hennig, cited earlier, suggest that sherds should accumulate differentially on a site. Clustering should also be expected on a smaller scale, however. Even given the reuse of large sherds, we would expect broken vessels to have been discarded as piles of sherds, not as single items. Trampling by both people and animals, weathering and leaching particularly, of weaker constructed vessels, and other destructive processes could be expected to further comminute discarded ceramics, leaving them roughly in place, and thus producing the appearance of an even tighter clustering of *sherds* than was present to begin with.

Expecting a clustered distribution in the first place does not, however, obviate the use of distribution statistics for examining the distribution of artifact categories:

> . . . it is often *un*reasonable to postulate that a pattern is random; or, if not positively unreasonable, there may at least be no particular grounds for favoring the hypothesis of randomness over any other imaginable pattern. The V/m ratio should then be regarded not as a test criterion but merely as a sample statistic descriptive of a population's pattern . . . If V/m is found to be close to 1, this should not prompt the conclusion that the pattern is truly random in the sense that the individuals are independent and the expected number per unit is the same for all units (Pielou 1977: 125; emphasis in the original).

Since we therefore do *not* expect a random or random appearing distribution to have been generated by cultural processes, the critical problem for the ceramic spatial analysis becomes the examination of what is clustered, and at what scale it is clustered.

Means, variances, and variance/mean ratios were calculated for sherds of each temper type with each of the upper six arbitrary levels (Table 12.6) and for each size class within each of the upper six levels (Table 12.7) in the ceramic sample from Block C. Comparison of these ratios shows feldspar tempered ceramics to be the most highly aggregated category in all levels but 4, where sand tempered pottery is very tightly clustered. Similarly, sherds in the ⟨ ½″ and ½″ – 1″ size classes are more highly aggregated in the upper four levels than they are in levels 5 and 6 and, except for level 4, are more aggregated than are the sherds in the 1″ – 2″ and ⟩ 2″ size classes. Discussion of these distributions is best accomplished by level.

Level 1 – Feldspar tempered sherds are the most highly aggregated ceramic group in this level, although they occur throughout the block (Fig. 12.11). Quartz tempered sherds are present in considerably smaller quantities, however, their distribution is similar to that of feldspar tempered sherds in this level (Fig. 12.11), an observation apparent from both

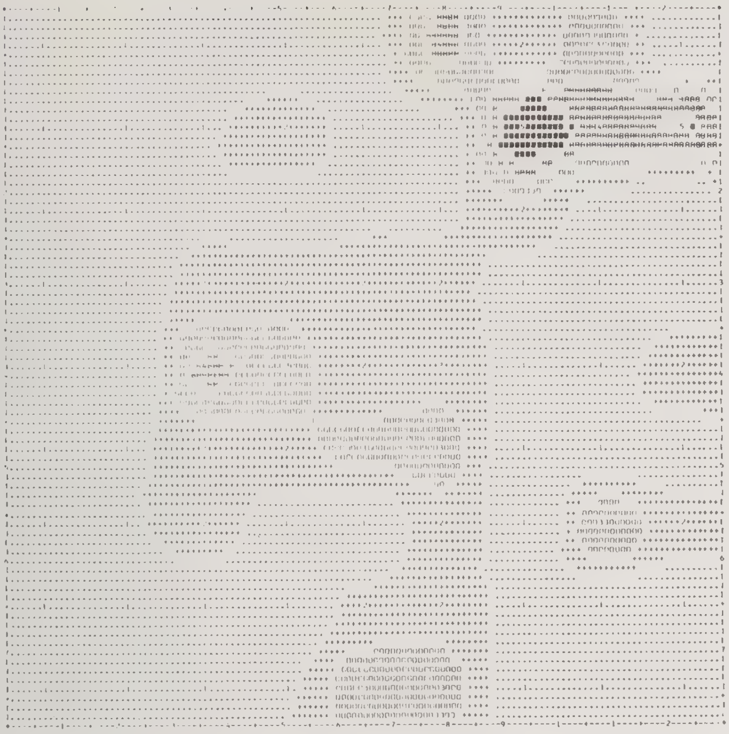
the maps and from the correlation between sherd frequencies at this level (Table 12.8). Sand tempered, grit tempered, and grog tempered sherds occur in small concentrations of a few sherds each, scattered throughout the block (Fig. 12.11). There is little congruence between these clusters, an observation borne out by the low correlations between sherd frequencies in the various temper categories (Table 12.8). The relatively high aggregation ratios for sherds in the ‹ ½″ and ½″ – 1″ size classes are most likely a product of the predominance of the badly comminuted feldspar tempered ceramics (Table 12.9). Larger sherds show lower aggregation values, suggesting that they probably are present as one or two large sherds in the midst of varying numbers of small sherds.

Level 2 – Feldspar tempered ceramics are again the most highly aggregated ceramic at this level (Table 12.6), occurring throughout the block but in more discretely bounded groups (Fig. 12.12). This is not unexpected given that this level, and succeeding levels, show considerably less disturbance than does level 1. Quartz tempered sherds also occur in more discretely bounded groups than in level 1, but show considerably less spatial congruence with feldspar than they did before (Fig. 12.12), an observation also evidenced by the very low correlation between these two temper categories (Table 12.10).

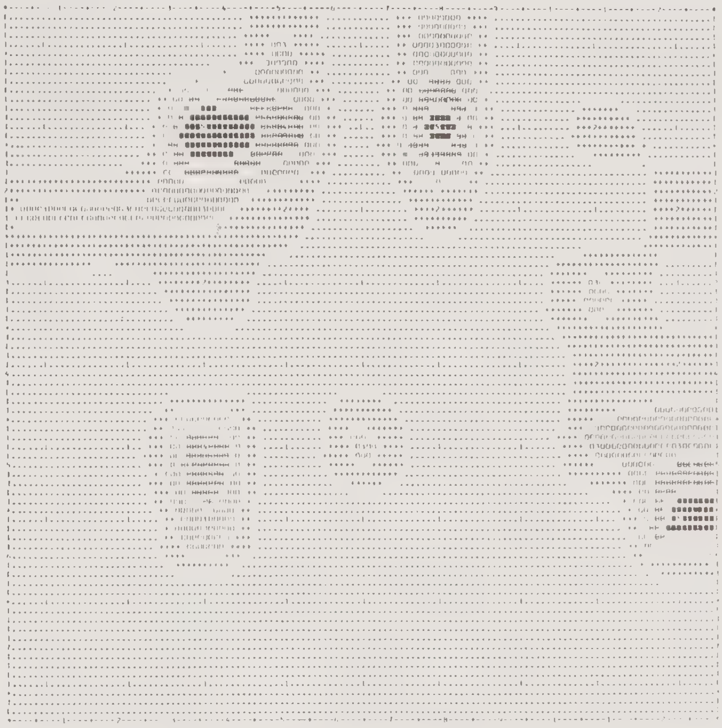
Sand and grit tempered sherds are present in each of several small groups of a few sherds each (Fig. 12.12) dispersed throughout the level and largely unrelated to any other temper category in occurrence (Table 12.10). The three grog-tempered sherds each occur in different squares near the center of the block. As with level 1, sherds in the ‹ ½″ and ½″ – 1″ size classes are relatively highly aggregated and probably for the same reason (Table 12.11); larger sherds are less highly aggregated (Table 12.7).

Level 3 – Feldspar tempered ceramics again show the highest variance/mean ratio (Table 12.6); however, the variance/ mean ratio for sand tempered sherds also dramatically increases from the previous level. Both classes occur in relatively discretely bounded groups of sherds, with the groups being scattered throughout the square (Fig. 12.13), but not congruent with one another (Table 12.12). Quartz and grit tempered sherds occur in small numbers, expectedly, therefore appearing to show small discrete groups (Fig. 12.13). Interestingly, however, these two groups have a considerably higher than usual degree of spatial congruence (Table 12.12). Grog tempered sherds are not present in this or succeeding levels. Sherds in the ‹ ½″ and ½″ – 1″ size classes again appear relatively highly aggregated. Larger sherds, particularly in the 1″ – 2″ size classes show increasing aggregation values (Table 12.7). A comparison of temper and sherd size within the level (Table 12.13) suggests that much of the increase in aggregation of larger sherds obtains from the presence of a number of large sand tempered sherds.

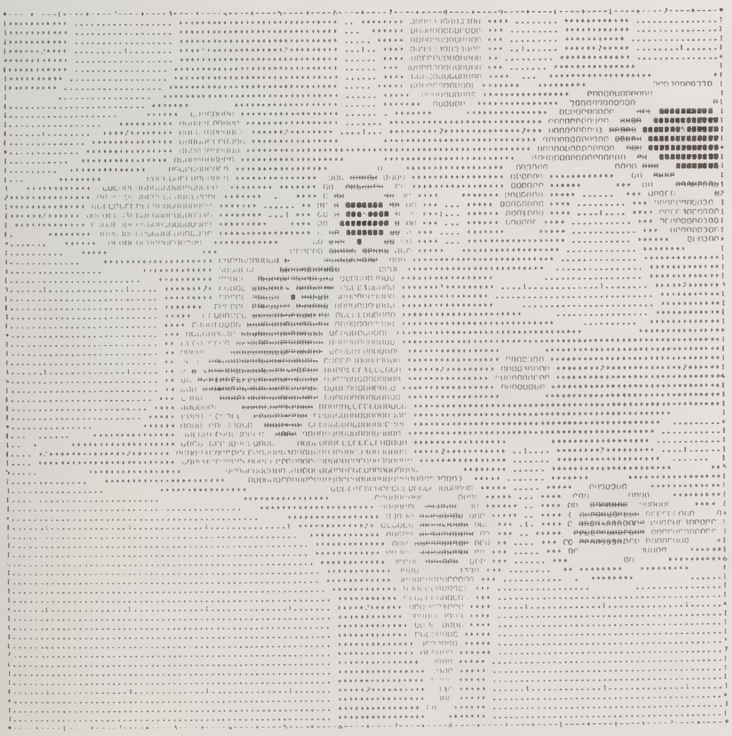
Level 4 – While feldspar tempered ceramics again have a high variance/mean ratio, the value for sand tempered sherds greatly exceeds any other single value (Table 12.6). Moreover, sand tempered sherds are most highly clustered at a single dense location (Fig. 12.14).



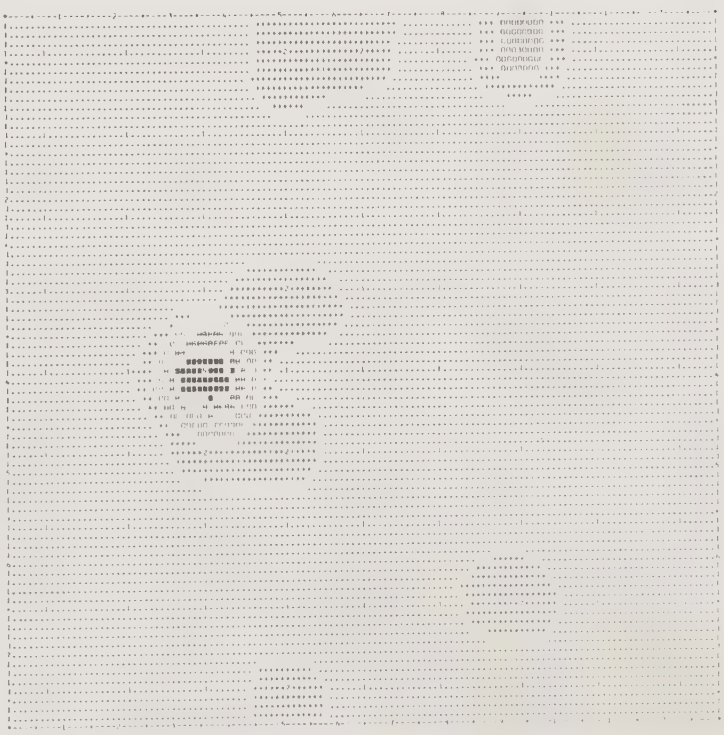
QUARTZ TEMPERED SHERDS



SAND TEMPERED SHERDS



FELDSPAR TEMPERED SHERDS



GRIT TEMPERED SHERDS

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FIGURE 12.11
LEVEL 1 CERAMICS

TABLE 12.6
MEANS, VARIANCES, AND VARIANCE/MEAN RATIOS – TEMPER TYPES, LEVELS 1-6

		Mean	Variance	V/m
Quartz –	Level 1	2.1	6.0	2.9
	Level 2	0.9	1.7	1.8
	Level 3	0.8	2.0	2.5
	Level 4	0.5	1.4	2.9
	Level 5	0.2	0.3	1.4
	Level 6	0.056	0.054	.96
Sand –	Level 1	1.2	2.8	2.4
	Level 2	0.6	1.6	2.7
	Level 3	1.7	9.2	5.5
	Level 4	1.8	25.0	13.6
	Level 5	0.8	3.3	3.9
	Level 6	.24	.27	1.1
Feldspar –	Level 1	9.5	64.9	6.8
	Level 2	5.3	41.7	8.0
	Level 3	5.4	40.5	7.5
	Level 4	5.2	32.3	6.3
	Level 5	3.0	13.6	4.5
	Level 6	1.5	7.3	5.0
Grit –	Level 1	0.5	0.9	1.8
	Level 2	0.3	0.7	2.6
	Level 3	0.3	0.5	1.9
	Level 4	0.3	0.7	2.6
	Level 5	0.2	0.6	2.5
	Level 6	0.042	0.07	1.7
Grog –	Level 1	0.11	.13	1.1
	Level 2	0.04	.04	1.0

TABLE 12.7
MEANS, VARIANCES, AND VARIANCE/MEAN RATIOS – SIZE CLASSES, LEVELS 1-6

			Mean	Variance	V/m
〈 ½″	–	Level 1	5.5	31.1	5.7
		Level 2	2.5	10.7	4.3
		Level 3	2.9	15.4	5.3
		Level 4	2.9	13.5	4.6
		Level 5	1.6	4.6	2.8
		Level 6	.6	1.4	2.3
½″ – 1″	–	Level 1	7.0	36.6	5.2
		Level 2	4.0	17.3	4.4
		Level 3	4.0	16.7	4.1
		Level 4	3.5	12.9	3.7
		Level 5	2.0	4.4	2.2
		Level 6	.9	2.1	2.2
1″ – 2″	–	Level 1	0.8	1.1	1.4
		Level 2	0.5	0.8	1.7
		Level 3	1.1	2.9	2.6
		Level 4	1.1	7.9	7.2
		Level 5	0.6	1.2	2.1
		Level 6	.17	.31	1.9
$\underline{\rangle}$ 2″	–	Level 1	.04	.04	1.00
		Level 2	.04	.04	1.00
		Level 3	.08	0.10	1.3
		Level 4	.24	1.12	4.7
		Level 5	.09	.08	.9
		Level 6	.07	.12	1.8

TABLE 12.8
CORRELATIONS OF SHERD FREQUENCIES – LEVEL 1

	Q	S	F	Gt
S	.09			
F	.64	.22		
Gt	.23	.01	.29	
Gg	.18	–.01	–.02	.02

TABLE 12.9
CROSSTABULATION OF AREA AND TEMPER – LEVEL 1

	Q	S	F	Gt	Gg	Total
< 1/2″	49	41	337	10	2	439
1/2″-1″	102	37	388	27	7	561
1″-2″	17	13	32	2	0	64
≥ 2″	0	0	3	0	0	0
Total	168	91	760	39	9	1067

TABLE 12.10
CORRELATIONS OF SHERD FREQUENCIES – LEVEL 2

	Q	S	F	Gt
S	.10			
F	.19	.01		
Gt	.17	-.03	-.06	
Gg	-.14	.06	.17	-.06

TABLE 12.11
CROSSTABULATION OF SHERD AREA AND TEMPER – LEVEL 2

	Q	S	F	Gt	Gg	Total
< 1/2″	15	9	169	7	1	201
1/2″-1″	55	24	227	11	1	318
1″-2″	3	15	17	3	1	39
≥ 2″	0	0	3	0	0	3
Total	73	48	416	21	3	561

TABLE 12.12
CORRELATIONS OF SHERD FREQUENCIES – LEVEL 3

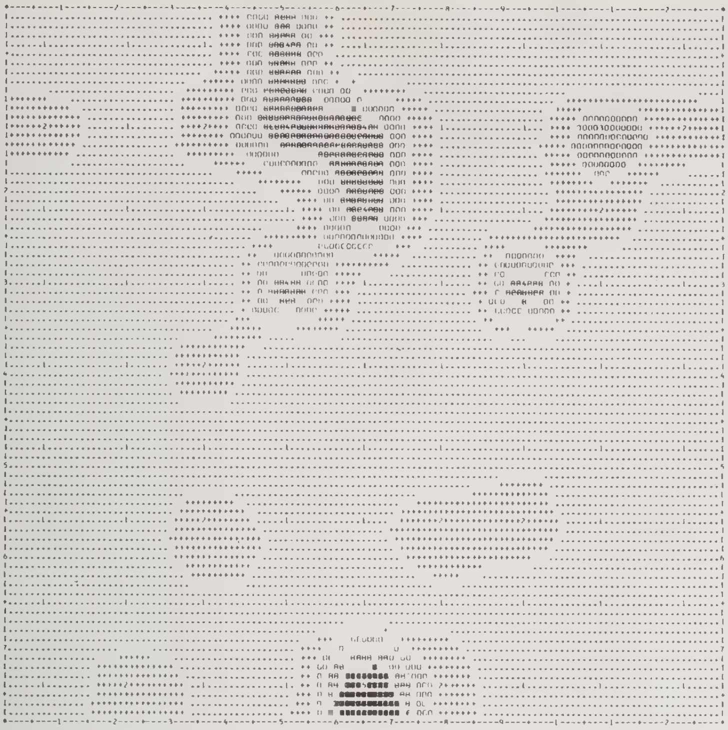
	Q	S	F
S	.25		
F	.19	.08	
Gt	.52	.09	.09

TABLE 12.13
CROSSTABULATION OF SHERD AREA AND TEMPER – LEVEL 3

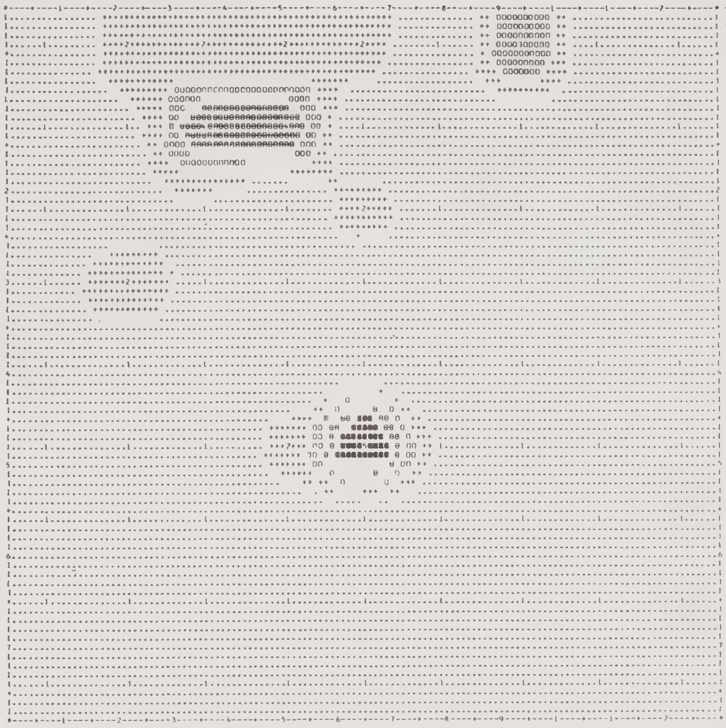
	Q	S	F	Ft	Total
< 1/2″	16	22	189	6	233
1/2″-1″	42	54	218	9	323
1″-2″	6	53	26	5	90
≥ 2″	0	5	1	0	6
Total	64	134	434	20	652

TABLE 12.14
CORRELATIONS OF SHERD FREQUENCIES – LEVEL 4

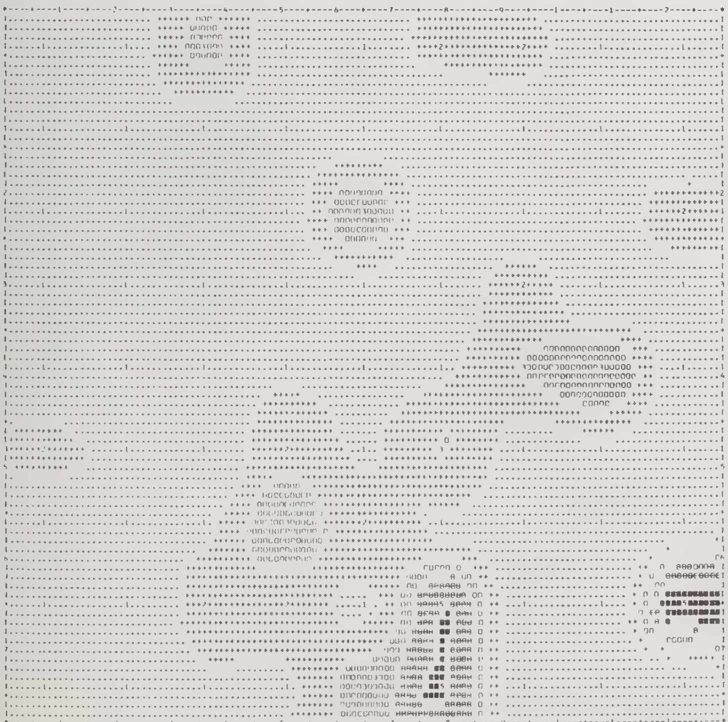
	Q	S	F
S	.04		
F	.28	-.02	
Gt	.30	-.04	.17



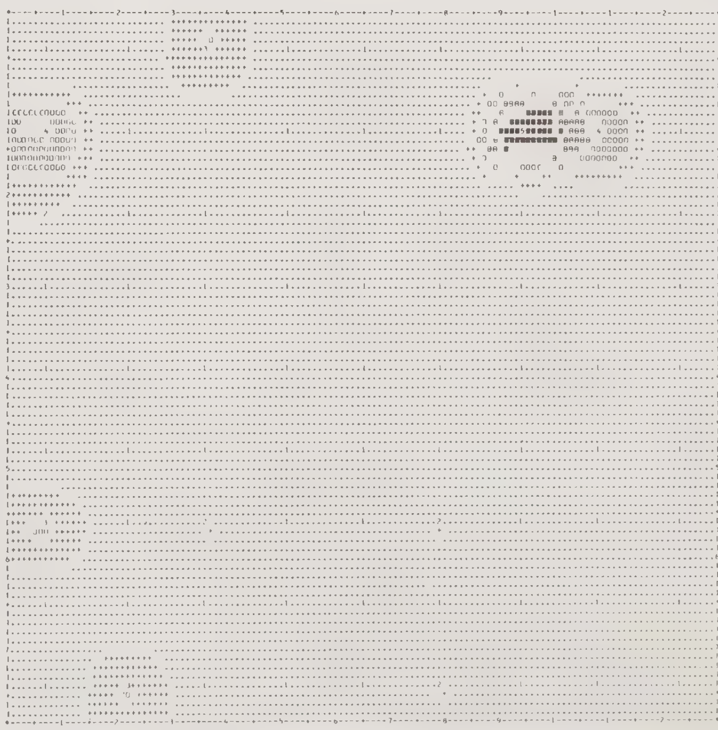
QUARTZ TEMPERED SHERDS



SAND TEMPERED SHERDS



FELDSPAR TEMPERED SHERDS



GRIT TEMPERED SHERDS

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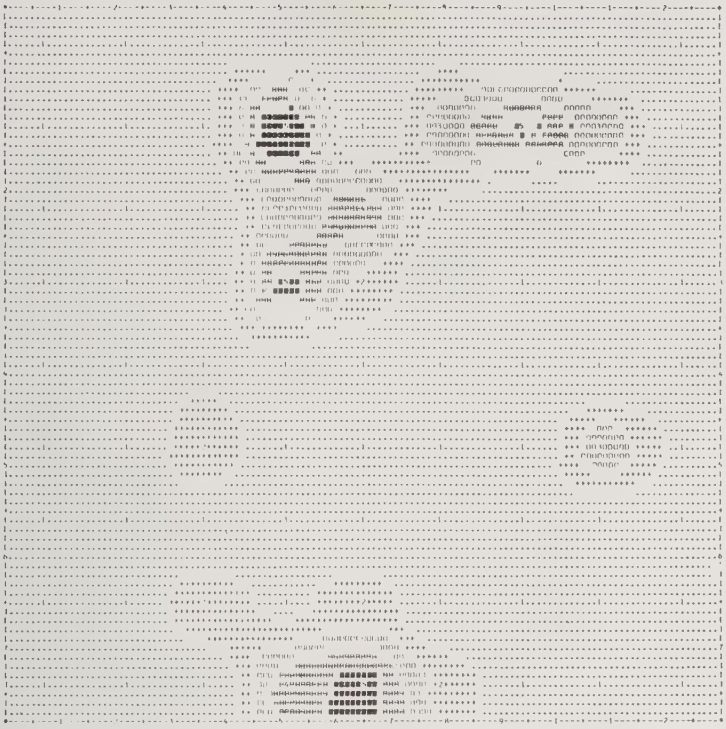
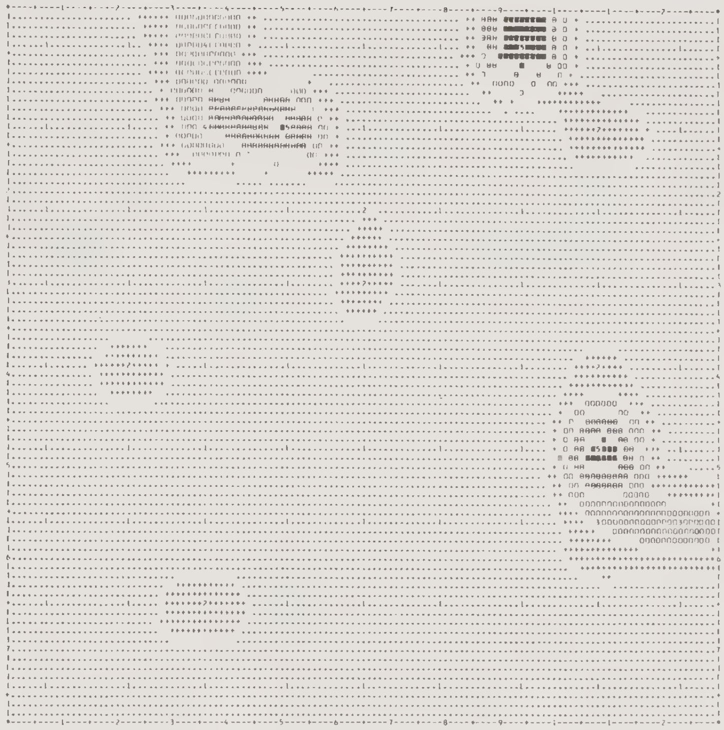
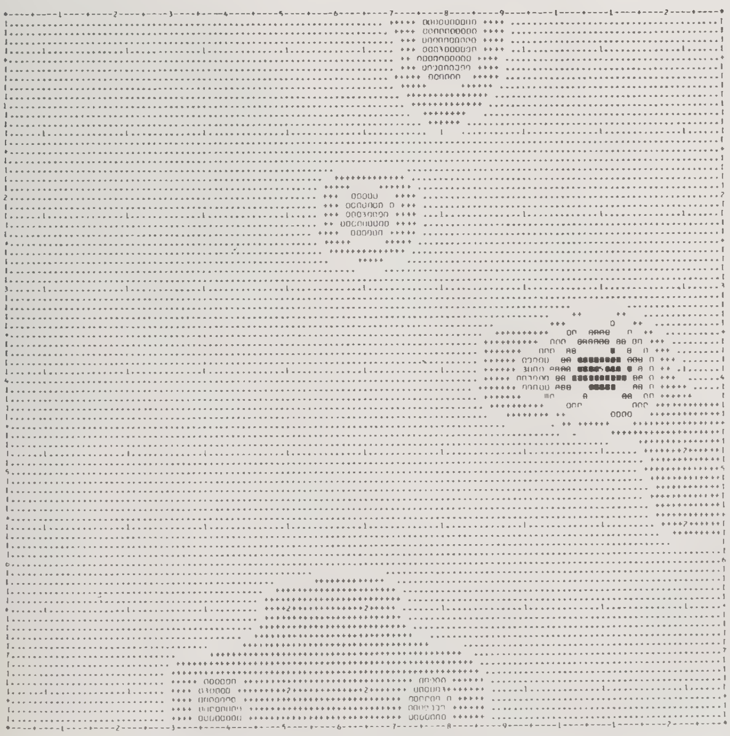
FIGURE 12.12
LEVEL 2 CERAMICS



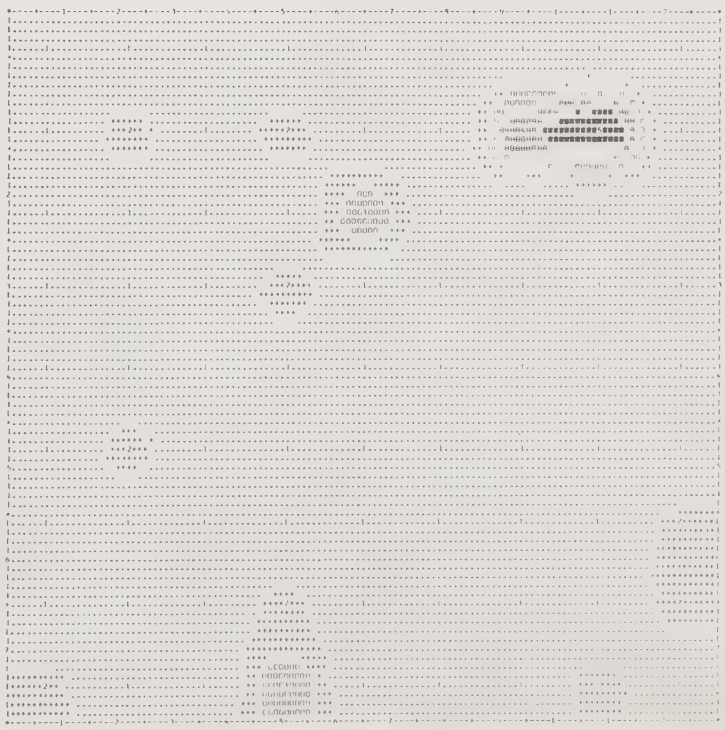
QUARTZ TEMPERED SHERDS



SAND TEMPERED SHERDS



FELDSPAR TEMPERED SHERDS



GRIT TEMPERED SHERDS

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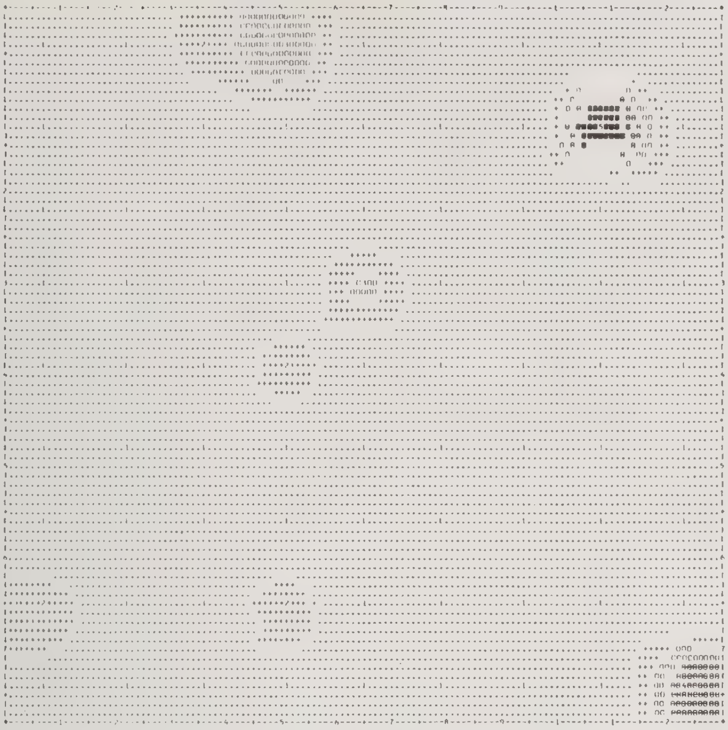
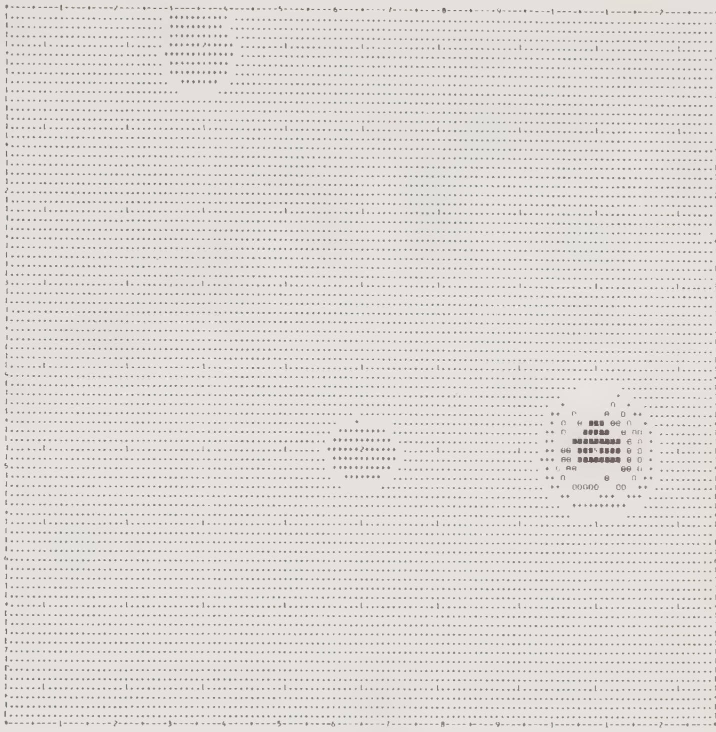
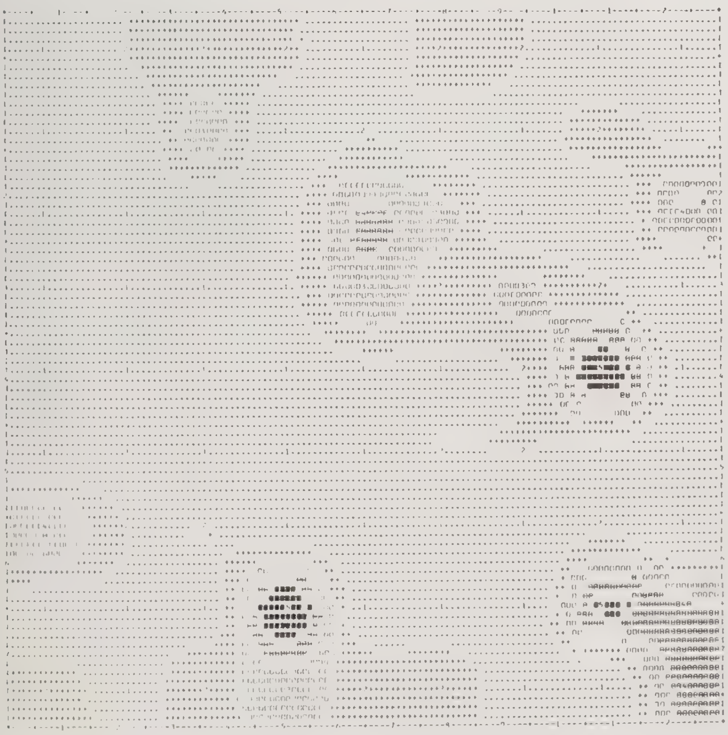
FIGURE 12.13
LEVEL 3 CERAMICS



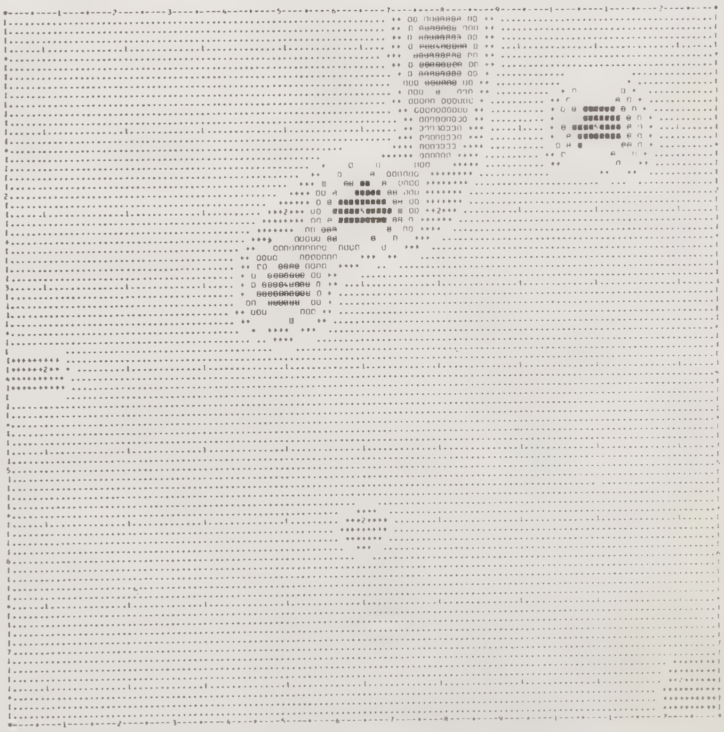
QUARTZ TEMPERED SHERDS



SAND TEMPERED SHERDS



FELDSPAR TEMPERED SHERDS



GRIT TEMPERED SHERDS

FIGURE 12.14
LEVEL 4 CERAMICS

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Feldspar tempered ceramics, on the other hand, are concentrated at several locations dispersed throughout the level (Fig. 12.14). Quartz and grit tempered ceramics, as usual, are less highly aggregated and occur in small groups of a few sherds each (Fig. 12.14) which show only a low degree of spatial congruence (Table 12.14). Small sherds, those in the $<$ ½″ and ½″ – 1″ size classes, continue to appear reasonably highly aggregated (Table 12.7) but now, at this level alone, the larger sherds show even higher variance/mean ratios than do the smaller sherds. As in level 3, where variance/mean ratios for larger sherds started to rise, much of the clustering of large sherds is due to the presence of a significant number of large sand tempered sherds (Table 12.15), most of them associated with the single dense cluster visible in the east-central portion of the square. This area was diagnosed in the field as a single "pot-bust" feature. Clearly, it began in level 4 and extended upward for 10-15 cm – accounting for the large number of large sand tempered sherds in levels 2 and 3 as well as 4.

Level 5 – Feldspar tempered ceramics are once again the most highly aggregated temper category, with sand tempered sherds running a close second (Table 12.16). Feldspar tempered sherds are largely concentrated in two areas of the level (Fig. 12.15). Aggregations of sand tempered sherds are small and reasonably discrete, but are not at all related to the pot-bust in the high levels (compare Figs. 12.14 and 12.15). Quartz and grit tempered sherds occur in small groups with low sherd frequencies (Fig. 12.15). There is virtually no congruence in the occurrence of various temper groups (Table 12.16). The variance/mean ratios for all three size classes $<$ ½″, ½″ – 1″ and 1″ – 2″ are similar and do not denote particularly high degrees of aggregation, while that for sherds $\geq$ 2″ is approximately what would be expected of a random distribution. Except for the fact that an unusually large proportion of the grit tempered sherds are large (Table 12.17) this clustering is probably nothing more than a reflection of the general tendency of the sherds to be clustered and of the previously described differential breakage of sherds with different tempers.

Level 6 – Overall sherd density is low in this level and most temper categories exhibit relatively random appearing distributions independent of one another (Tables 12.18 and 12.19). The major exception is, as usual, the category of feldspar tempered sherds, which here are almost completely confined to the southwest corner of the level (Fig. 12.16). Sand tempered sherds occur in groups of no more than two sherds in a square and are dispersed throughout the block (Fig. 12.16), while grit and quartz tempered ceramics are represented by only a few sherds (Fig. 12.16). Similarly, sherds size groups exhibit slight aggregation most likely reminiscent of general distribution.

Level 7 – Only 69 sherds, most of them feldspar tempered, were present in this level. Ceramics were, however, concentrated in the southwest corner of the square, primarily in EU 7 and the contiguous portion of EU 8. This area was noted in the field to show considerable disturbance. The majority of the sherds are feldspar tempered and are small ($<$ 1″). A few sand tempered or feldspar tempered sherds and one grit tempered sherd were found beyond this area.

Level 8 — All of the 25 sherds in this level are either sand or feldspar tempered. Six feldspar and one sand tempered sherd occur as small groups of sherds, the remaining 19 are in the disturbed area in the southwest corner.

Level 9 — A total of 24 sherds were found in this level; 17 of these are in EU 7. The other seven are in small groups, dispersed throughout the square — including one small group in the northwest corner that contains three sand tempered sherds and one sherd coded as quartz tempered.

Level 10 — All 12 sherds in this level are feldspar tempered. Eleven sherds are in EU 7, the other is across the block in EU 6, Square i.

Level 11 — Two feldspar and one sand tempered sherd are in EU 7.

Level 12 — The single feldspar tempered sherd in this level is in EU 6, Square i.

Discussion

The tendency of sherds to aggregate by temper groups which in turn show little spatial congruence suggests that, throughout the successive occupations, the area excavated as Block C was the scene of casual deposition of broken pottery. Aggregation of temper groups and the field identification of several "pot-bust" features suggests that all or major portions of broken vessels were discarded or abandoned. Following deposition, some disturbance occurred and had the chief effect of further comminuting the broken vessel sections. Disturbance processes could have included weathering and deterioration of vessels and perhaps trampling as well. In either event, any subsequent activity produced little lateral displacement of individual ceramic fragments.

Vessels of different temper categories likely have different strengths and thus, once discarded, were differentially comminuted. Sand-tempered ceramics seem to be the least badly broken, although this may reflect nothing more than the presence of one or two unusually well-preserved sand-tempered vessels. (But then, why are they unusually well-preserved?)

Overall, the ceramics found in the 31Ch8 excavations apparently represent comparatively few vessels from few discard episodes. If we may assume that as stated by DeBoer and Lathrap 1979:129), ". . .midden accumulates exactly where behavioral is minimal", then we might in turn suggest that there was little human activity enacted in the excavated area subsequent to ceramic discard. Several reasons may be added to account for this fact including either major activity concentrated at an unexcavated portion of the site or casual use only of the site area during each successive occupation. Placing ceramics in their context with the tools from the site will allow an evaluation of these alternatives.

TABLE 12.15
CROSSTABULATION OF SHERD AREA AND TEMPER – LEVEL 4

	Z	S	F	Gt	Total
< 1/2"	20	22	188	4	234
1/2"-1"	15	57	196	10	278
1"-2"	3	54	24	6	87
≥ 2"	0	14	4	1	19
Total	38	147	412	21	618

TABLE 12.16
CORRELATIONS OF SHERD FREQUENCIES – LEVEL 5

	Q	S	F
S	.09		
F	-.03	-.06	
Gt	-.03	-.04	.04

TABLE 12.17
CROSSTABULATION OF SHERD AREA AND TEMPER – LEVEL 5

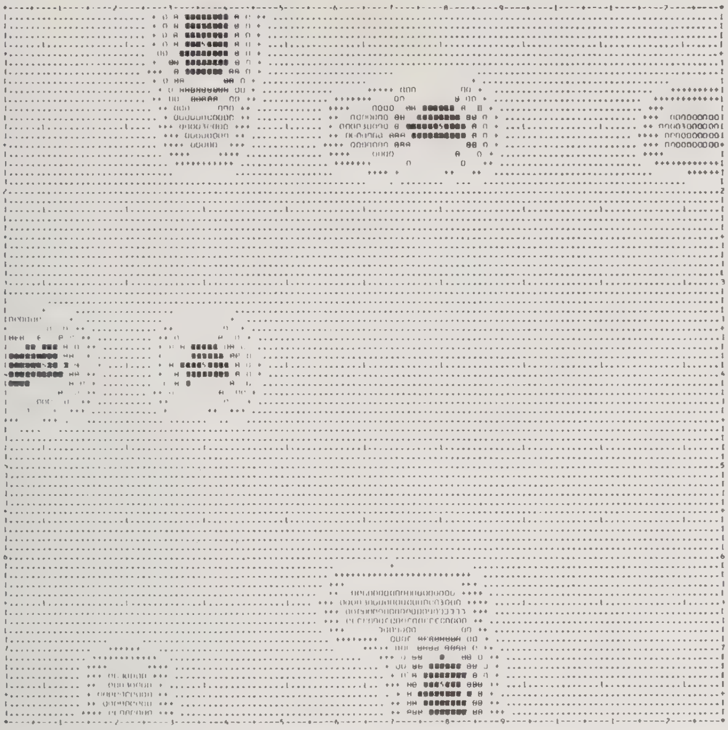
	Q	S	F	Gt	Total
< 1/2"	4	13	98	1	116
1/2"-1"	12	31	95	6	114
1"-2"	0	15	21	7	43
≥ 2"	0	1	2	3	6
Total	16	60	216	17	309

TABLE 12.18
CORRELATIONS OF SHERD FREQUENCIES — LEVEL 6

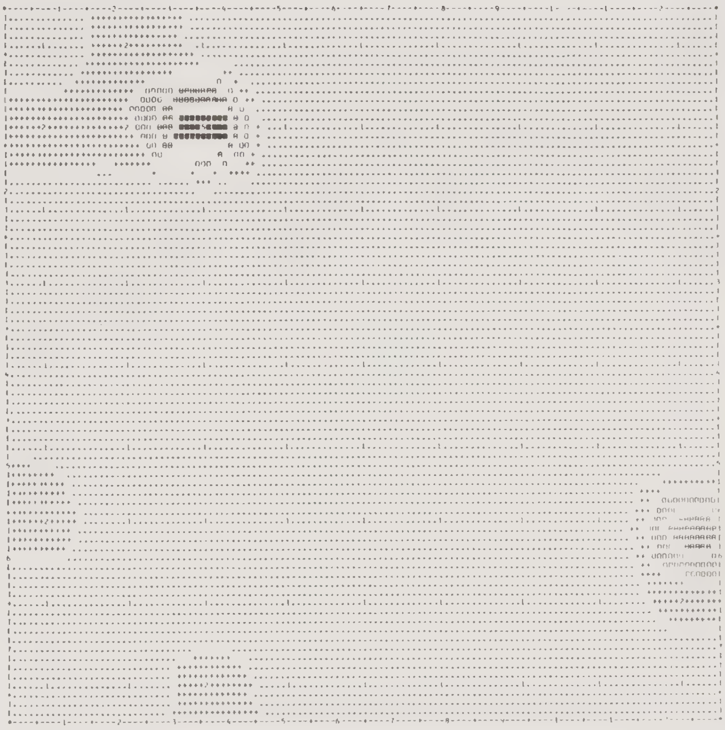
	Q	S	F
S	.01		
F	-.06	.01	
Gt	-.04	.13	-.09

TABLE 12.19
CROSSTABULATION OF SHERD AREA AND TEMPER — LEVEL 6

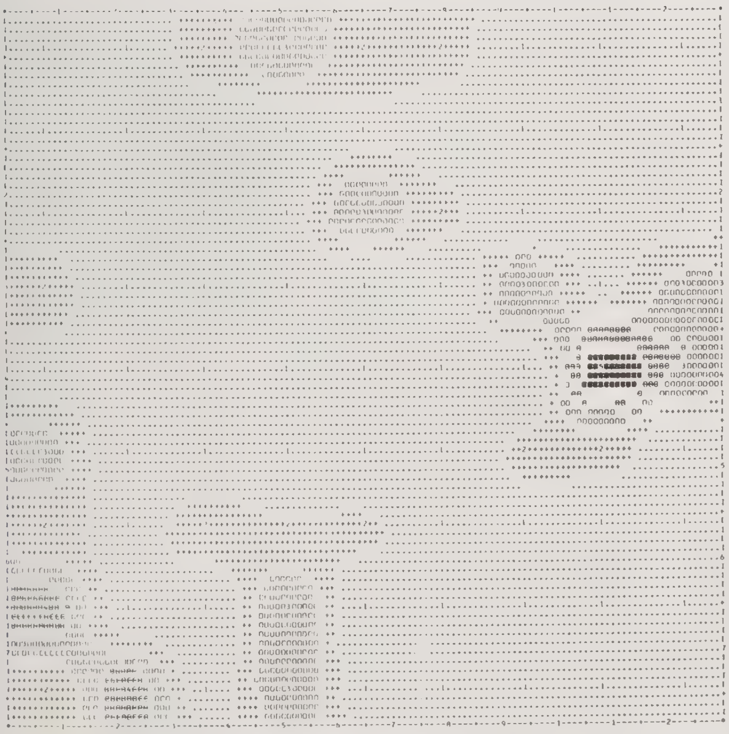
	Q	S	F	Gt	Total
< 1/2"	1	4	38	0	43
1/2"-1"	3	9	52	3	67
1"-2"	0	1	11	0	12
≥ 2"	0	3	2	0	5
Total	4	17	103	3	127



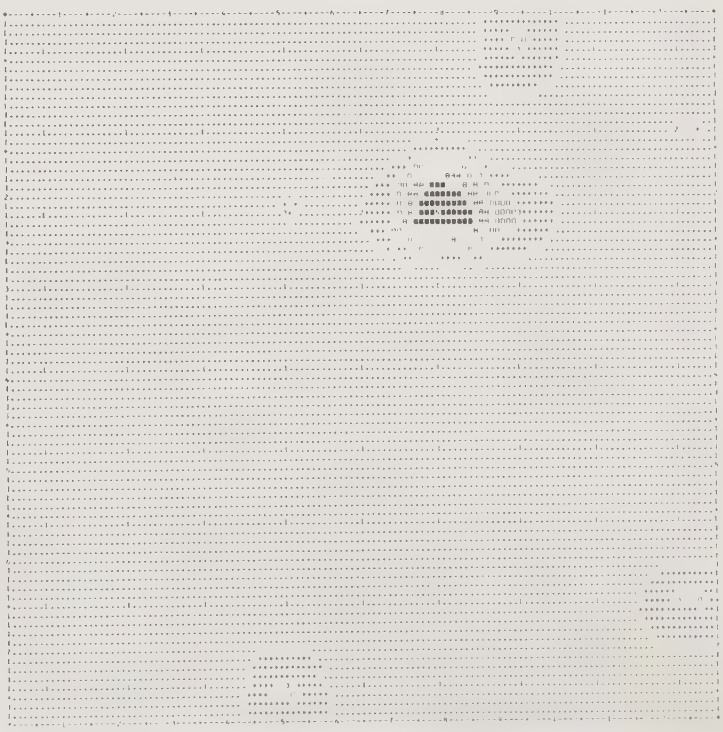
QUARTZ TEMPERED SHERDS



SAND TEMPERED SHERDS



FELDSPAR TEMPERED SHERDS



GRIT TEMPERED SHERDS

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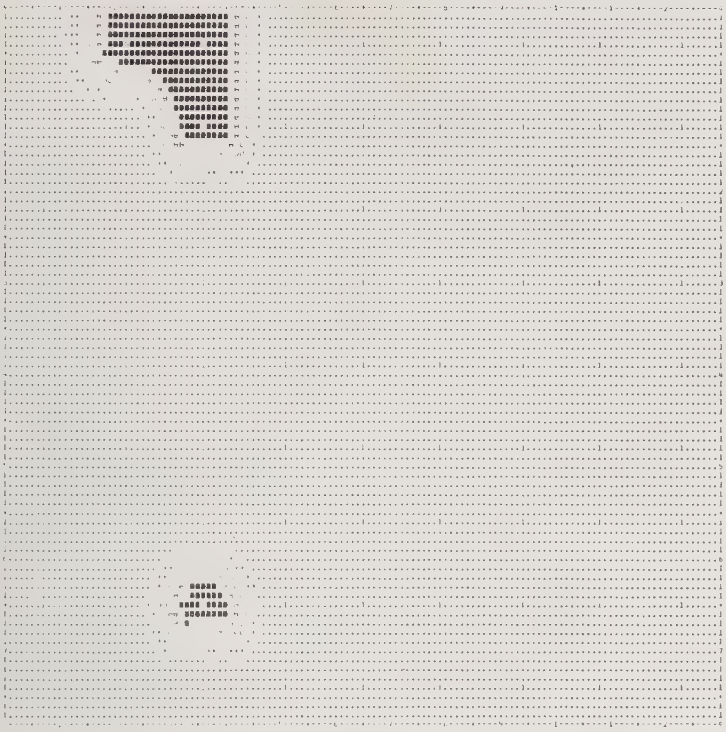
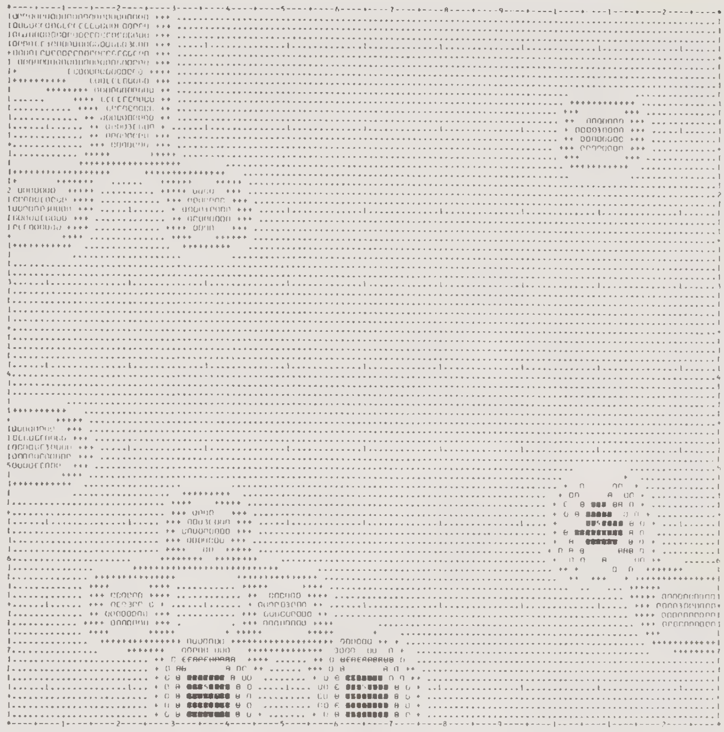
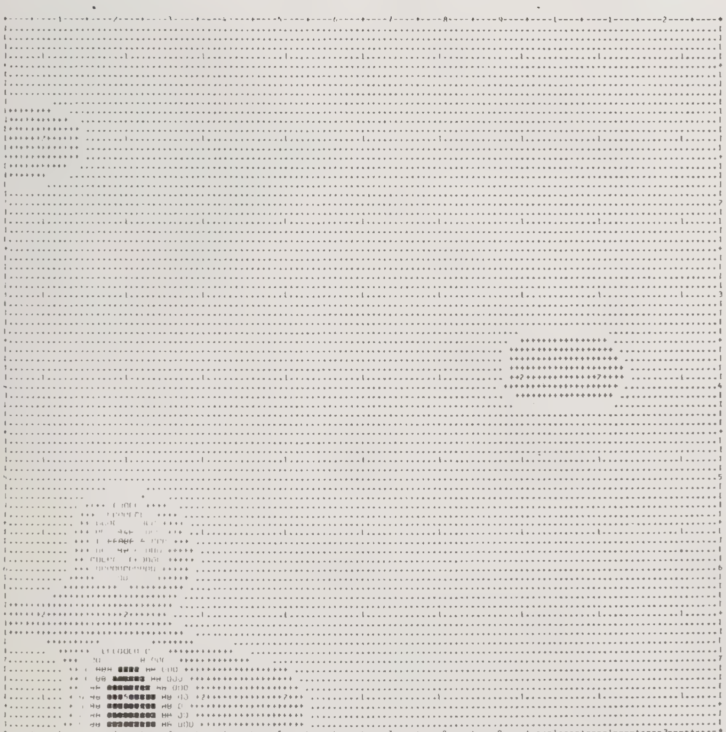
FIGURE 12.15
LEVEL 5 CERAMICS



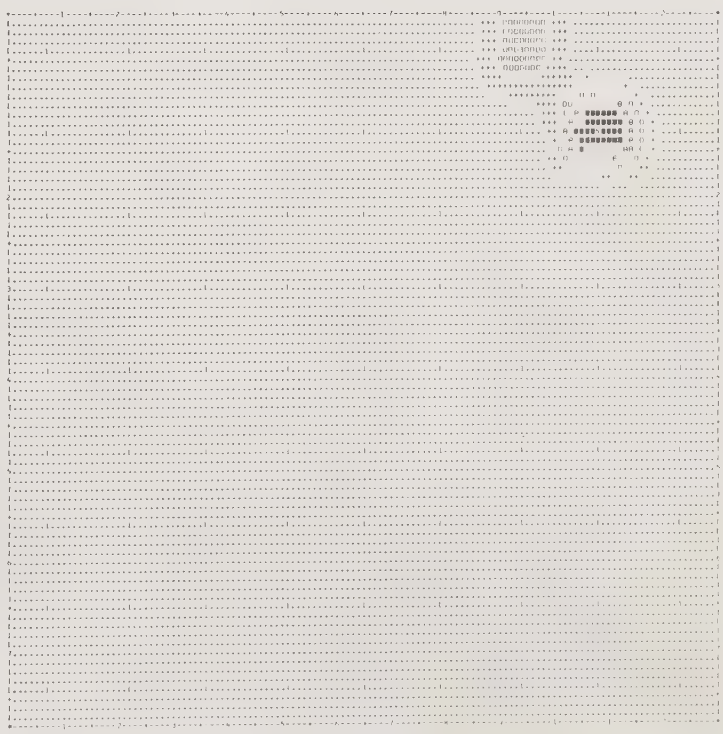
QUARTZ TEMPERED SHERDS



SAND TEMPERED SHERDS



FELDSPAR TEMPERED SHERDS



GRIT TEMPERED SHERDS

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FIGURE 12.16
LEVEL 6 CERAMICS

SPATIAL ANALYSIS OF LITHIC TOOL DATA FROM 31Ch8

Full interpretation of disposal and spatial pattern in the deposits excavated at 31Ch8 requires examination of whole assemblages. Three categories of artifacts were used for this analysis: curated tools, expedient tools, and ceramics. The curated tools include those tools described in Chapter 9 as hafted bifaces and fragments of hafted bifaces, bifaces — both fragmentary and complete — drills, adzes, and core/choppers. Expedient tools, or situational gear, include those tools further described as retouched flakes, edge-damaged flakes, cores, and "planes". Ceramics are entered as simple sherd counts; temper and size classes are ignored at this level of analysis. As with the ceramic spatial analysis, artifacts are horizontally provenienced by 1 meter squares. Unlike the ceramic analysis, however, vertical provenience is by strata, as defined in Chapter 9, rather than by arbitrary level.

Analytic techniques for the 31Ch8 assemblage analysis are the same as those used for the analysis of the 31Ch29 assemblages, i.e., the analysis is based on the use of the variance/mean ratio to describe spatial pattern. Grid scale has been varied and includes 1 x 1, 2 x 2, 3 x 3, and 4 x 4 m blocks. For the even numbered block sizes, some squares were necessarily omitted. These were always those bordering the north and east edges of the block. Results of the analysis are described stratum by stratum, and from the bottom up.

Stratum 4 — Late Archaic-Early Woodland — The lowest excavated stratum at Block C, 31Ch8 contained 37 curated tools, 16 expedient tools, and 146 sherds. The ratio of curated tools to expedient tools is 2.3:1, of sherds to curated tools is 3.9:1, and of sherds to expedient tools is 9.1:1. Computations of means, variances, and variance/mean ratios for grid sizes 1 x 1, 2 x 2, and 3 x 3 m only (the middle EU of this stratum was unexcavated) gave results as follows:

Grid	curated tools			expedient tools			ceramics		
Size	m	v	v/m	m	v	v/m	m	v	v/m
1 x 1	.52	.85	1.63*	.23	.26	1.16	2.06	22.14	10.77*
2 x 2	1.67	4.79	2.87*	.83	.88	1.05	10.33	375.15	36.30*
3 x 3	4.63	12.55	2.71*	2.00	2.00	1.00	18.25	955.07	52.33*

The clustering of ceramics at each scale of the analysis was expected and, in light of the earlier discussion of ceramic disposal modes, would probably not have been tested for were it not also desirable to make comparisons with tool distributions. It will also be noted that expedient tools appear randomly distributed at all scales of analysis, while curated tools in this stratum appear clustered at all scales and most markedly so at the 2 x 2 m scale.

The major reason for the appearance of clustering at the 2 x 2 m scale is the concentration of these tools in the southeast corner of the block. This cluster is comprised of a variety of kinds of tools, including bifaces, hafted bifaces, and an adz. A correlation matrix between the three possible pairs of artifact types at the 2 x 2 m grid size was also calculated:

	Curated tools	Expedient tools
Expedient tools	-.11	
Ceramics	-.26	-.14

Given the lack of clustering of expedient tools, it is not surprising that curated tools and expedient tools are virtually uncorrelated. However, it is also apparent from inspection of the correlation matrix that the locations of tools and ceramics are also uncorrelated. The majority of the ceramics in fact occur in the southwestern corner of the block (Figure 12.17), in a cluster that shows very little spatial overlap with the cluster of curated tools. It has already been shown, however, that ceramics occur in some quantities in lower levels in the southwest corner than elsewhere in the block. This may result from disturbance or former cultural activity.

Overall, space in this stratum is differentiated but not particularly highly organized. Only two of three artifact classes appear clustered and the 2 x 2 m square scale is that at which clustering appears maximal. The three artifact classes are virtually uncorrelated in their occurrence, which, coupled with the small scale of clustering leaves the impression of casual disposal of artifacts from each class.

Stratum 3 — Woodland — Sixty tools and 521 sherds were recovered from this stratum and used in the analysis. The tools total includes 50 curated tools and 10 expedient tools for a curated tool: expedient tool ratio of 5:1. Ceramics in this stratum assume a more prominent role in the assemblage, sherds appearing in a 10.4:1 ratio to curated tools and a 52:1 ratio to expedient tools. Means, variances, and variance/mean ratios were calculated for each class at the scale of 1 x 1, 2 x 2, 3 x 3, and 4 x 4 m:

Grid	curated tools			expedient tools			ceramics		
Size	m	v	v/m	m	v	v/m	m	v	v/m
1 x 1	.63	1.15	1.84*	.13	.11	.89	6.51	51.49	7.91*
2 x 2	2.56	6.13	2.39*	.63	.52	.83	26.06	297.53	11.42*
3 x 3	5.44	18.03	3.31*	1.11	.86	.78	55.56	1263.78	22.75*
4 x 4	10.25	51.58	5.03*	2.50	1.67	.67	104.25	2128.92	20.42*

As in stratum 4, curated tools and ceramics are clustered at each scale of analysis, while expedient tools appear randomly distributed, and even slightly dispersed. Clusters of curated

tools and ceramics are most marked at the 3 x 3 and 4 x 4 m scales. A correlation matrix calculated for the distribution of tools at the 3 x 3 m scale is:

	Curated tools	Expedient tools
Expedient tools	.21	
Ceramics	.73	-.14

Curated tools and ceramics do show a degree of spatial congruence that probably does not occur by chance. A glance at Figure 12.17 shows that both curated tools and ceramics occur in highest frequency in EU's 2, 5, and 6, while smaller numbers of tools and ceramics are found northeast and west and southwest of this scatter. We have already seen that ceramics in this stratum (generally levels 4-6) occur in small discrete groups, very possibly representing disposal of all or major parts of single vessels and subsequently largely undisturbed. This, of course, is also reflected in the clustering of ceramics shown here. Also of note is the presence of several small groups (caches?) of tools within this larger scatter of debris. This includes a group of hafted bifaces (especially contracting stemmed, Otarre, and Savannah River points) and bifaces approximately in the center of the block and a group of small lanceolate points near the north-central part of the block, although this latter may be intrusive.

Overall, this stratum may reflect the most organized division of space yet described for either 31Ch29 or 31Ch8. The conclusion to the ceramic spatial analysis suggested that behavior was likely minimal subsequent to ceramic disposal. The analysis of tools as well as ceramics also suggests minimal post-depositional activity in the excavated part of the block. It in fact suggests that much of the debris is secondary refuse representing expedient tools and broken vessels deposited in a designated part of the site area. It is curious that the density of expedient tools is low and that they do not spatially co-occur with the curated tools and ceramics. Perhaps a major change in technology has occurred and greater emphasis was placed on the use of tools that we latter-day archeologists have referred to as curated. In fact we might speculate that if the occupation was more sedentary, then a slightly greater expenditure of energy in tool manufacture might be repaid over the long run by longer tool life.

Stratum 2 - Early/Middle Woodland — The number of tools in this stratum is only slightly lower than it was in Stratum 3, but the frequency of ceramics has greatly increased. A total of 55 tools were entered in the analysis. This includes 46 curated tools and 9 expedient tools for a curated tool: expedient tool ratio of 5.1:1, a ratio virtually identical to that in Stratum 3. A total of 1244 sherds were recovered, however, and this is 2.39 times as many sherds as in Stratum 3. The sherd: curated tool ratio thus rises sharply to 27.0:1. while the sherd: expedient tool ratio rises to 138.2:1.

The statistics of the distribution of these tools were calculated as:

Grid Size	curated tools m	v	v/m	expedient tools m	v	v/m	ceramics m	v	v/m
1 x 1	.58	1.11	1.93*	.11	.13	1.12	15.55	282.43	18.16*
2 x 2	2.38	9.05	3.81*	.31	.50	1.59	56.63	1457.45	25.74*
3 x 3	5.11	25.11	4.90*	1.00	1.50	1.50	127.11	7506.36	59.06*
4 x 4	9.50	63.00	6.63	1.25	2.25	1.80	226.50	12392.33	54.71*

Once again the curated tools and curated tools and ceramics are clustered at all scales while expedient tools appear randomly distributed. Unlike Stratum 3, however, correlations do not suggest a particularly strong spatial congruence of artifact classes (3 x 3 m scale):

	Curated tools	Expedient tools
Expedient tools	.16	
Ceramics	.41	.60

Any one of these values could occur by chance more than 5 times in 100. Inspection of Figure 12.17, however, suggests that some spatial overlap occurs, however. Ceramics occur in highest frequency along the north and east edges of the block. Curated tools occur in greatest frequency at the northern edge of the block. It is this less than complete congruence, along with a secondary clustering of tools adjacent to but southwest of the majority of ceramics that lowers the correlations between these artifact classes.

Taken as a whole, however, the structure of the distribution of debris in Stratum 2 is similar to that in Stratum 3. Space is differentiated and is well marked at larger scales (3 x 3 and 4 x 4). Clustering of debris again seems to represent secondary refuse, deposited in designated areas of the site. The relation between curated and expedient tools remains the same, but ceramics have now assumed a considerably greater importance than in the preceding occupation.

Stratum I — Woodland/Protohistoric — The number of tools in this stratum was the highest of any stratum at 31Ch8. A total of 88 tools were included in the spatial analysis. This total is comprised of 64 curated tools and 24 expedient tools, for a curated tool: expedient tool ratio of 2.7:1. A total of 1534 sherds were also recovered from this stratum, or a recovery ratio of 24.0:1 of sherds to curated tools and 63.9:1 of sherds to expedient tools. We would suggest that the salient difference between this and the previous two strata is the renewed importance of expedient tools in the assemblage.

STRATUM 4 - 2 x 2 METER SCALE

CURATED TOOLS

1	0	1	2
1			0
1			2
0	1	3	8

EXPEDIENT TOOLS

0	0	0	2
3			1
1			1
0	1	1	0

CERAMICS

2	0	0	0
5			4
2			2
55	48	5	1

STRATUM 3 - 3 x 3 METER SCALE

CURATED TOOLS

0	8	2
5	9	14
3	4	4

EXPEDIENT TOOLS

0	1	0
3	1	1
1	1	2

CERAMICS

52	112	20
37	84	93
41	59	23

STRATUM 2 - 3 x 3 METER SCALE

CURATED TOOLS

10	16	4
4	6	2
2	0	2

EXPEDIENT TOOLS

0	2	2
2	0	3
0	0	0

CERAMICS

171	219	171
52	111	268
38	103	111

STRATUM 1 - 2 x 2 METER SCALE

CURATED TOOLS

0	0	2	8
4	4	1	6
5	1	1	5
4	7	2	2

EXPEDIENT TOOLS

0	0	1	3
0	2	1	3
1	2	2	1
1	3	0	0

CERAMICS

49	75	71	76
10	122	67	50
103	111	110	63
59	109	190	6

FIGURE 12.17
FREQUENCIES OF CURATED TOOLS, EXPEDIENT TOOLS, & CERAMICS-31CH8

The statistics of the distribution of tool categories were calculated as follows:

Grid	curated tools			expedient tools			ceramics		
Size	m	v	v/m	m	v	v/m	m	v	v/m
1 x 1	.80	.92	1.15	.30	.26	.88	19.18	171.13	8.92*
2 x 2	3.25	6.20	1.91*	1.25	1.27	1.01	79.48	2023.20	25.47*
3 x 3	7.11	12.11	1.70	2.67	3.75	1.41	170.44	5562.03	32.63*
4 x 4	13.00	22.00	1.69	5.50	5.67	1.03	317.75	4485.58	14.12*

The spatial pattern within the deposits is obviously very different than in the preceding two strata. Expedient tools appear randomly distributed, as they have throughout the 31Ch8 deposits. However, the hypothesis of a random distribution of the curated tools is rejected only at the 2 x 2 m scale, and then only barely. Ceramics are expectably clustered but by comparison are much less markedly clustered at all but the 2 x 2 m scale. Obviously, therefore, the 2 x 2 m scale is that at which it is most optimal to discuss spatial pattern in Stratum 1 and also obviously, this represents a reduction to a smaller size of the scale of clustering. Further, we may calculate a correlation matrix for tools in 2 x 2 m units as:

	Curated tools	Expedient tools
Expedient tools	.64	
Ceramics	-.03	.22

The correlations between curated and expedient tools is high, and in this respect is very unlike the other strata. The question is therefore, what has happened?

Unfortunately, part of the answer to this question must lie in the extensive disturbance that has affected this stratum, particularly its thick upper level. A possible mixture of several occupations has probably also affected the results. Inspection of Figure 12.17 makes this even clearer. Clusters of curated tools at the 2 x 2 m scale occur in several places throughout the block and, in fact, these clusters are sufficiently dispersed to present a random appearance at larger scales of analysis. Expedient tools occur in considerably lower frequency but have a distribution that in fact does resemble that of curated tools. Ceramic distributions are similar only in that the northwest and southeastern corners exhibit low frequencies of any artifacts.

The spatial pattern of artifacts in Stratum I is overall more difficult to interpret. The nearly random distribution of tools and the declining clustering of sherds at larger grid sizes suggest that disturbance processes have been such as to smear the remains around the block and largely destroy their context.

SUMMARY OF SPATIAL ANALYSIS RESULTS

Preceding discussions concentrated on defining the statistical bases for spatial patterning of cultural materials of 31Ch29 and 31Ch8. The quantitative approach utilized provides a means for objectively determining the strength of relationships between objects used to perform certain tasks. Due to circumstances of archeological site formation and preservation we cannot observe other less durable cultural by-products which were equally parts of those activities. References cited in earlier sections of this chapter illustrate some of the many ways archeologists have attempted to explain observed patterns of surviving artifacts in order to define the cultural (and, less often, natural) processes that conditioned their eventual arrangement in space.

The current effort at spatial analysis of artifact data from 31Ch29 and 31Ch8 proceeded in a straightforward fashion, beginning with statistical determinations of pattern configurations (regular, random or clustered) and followed by measurements of strengths of association between artifacts or groups of artifacts on archeologically defined occupation floors (Chapter 9). A third analytic step, the description of artifact clusters, has been partially accomplished in the discussions. The entire effort, however, remains incomplete without a final step, which is archeological interpretation and discussion of the presented statistical data in light of the model chosen to explore variations in tool assemblages and site functions. The model offers one means for explaining cultural behavior patterns through time, relative to long-term environmental changes which modified resource structures and, indirectly, the nature of cultural systems (settlement patterns technologies, etc.).

Without reiterating all the details of the proposed model (presented in Chapter 11), it can be generally said that we expect to observe diachronic variation in archeological remains from Early Archaic through Late Archaic and, possibly Woodland, which will reflect systemic changes characterized as *logistical* (collector) or *residential* (forager) settlement patterns (Binford 1980). Defined and somewhat contrastive elements of each system, relating to expected site types, resource procurement patterns and tool assemblages, have been previously discussed. This report section briefly examines some of those ideas in view of the statistically-based spatial analysis of artifacts from the several occupation zones at the two sites. The spatial analysis presented in this chapter is based primarily on the distributions of lithic tools classed as either curated or expedient forms, as defined by Binford (1976, n.d.) and as identified on a case-by-case basis during the lithic analyses (Chapter 9). Those fairly self-explanatory labels have been applied to artifacts which functioned within prehistoric systems either in a long-term (curated) or short-term (expedient) fashion. The importance of those dichotomous characterizations of assemblage elements to this discussion lies in their relative proportions and distributions on occupation floors, as potential indicators of site function and organization during limited periods of site usage.

Drawing on the presentation of the model in Chapter 11, a set of expectations can be generated which is relevant to the particular needs of spatial interpretations. Patterned variability in the lithic assemblages from 31Ch29 already has been discussed in terms of

an argument for a major shift from logistical-collector systems to residential-forager strategies some time between the Early Archaic Palmer and Kirk/Bifurcate substages (see Chapter 11 — A Model for Early to Mid Holocene Hunter-Gatherer Adaptive Change in North Carolina). As we now primarily are concerned with varying organization of space through time, it is more pertinent to consider internal site structure as a reflection of modelled expectations, rather than dealing only with interassemblage variability. Similar terminologies are maintained for characterizing occupations, since the interactions between technologies, subsistence bases and settlement types theoretically are accomodated by the model.

Therefore, a set of expectations for site occupations in terms of variable spatial organization through time can be derived from Chapter 11 discussions, as follows:

Logistical/Collector Systems — due to ecological factors promoting spatial and tempral incongruence of resources, we should observe coarse-grained human cultural responses during periods characterized by those conditions. Settlement strategies will involve recurrence of occupations at fixed loci, with intentions of exploiting predictable resources. Curated tools should characterize the associated assemblages and their occurrence should mirror discrete, anticipated activity sets. Since a basic dependence on animal resources has been postulated as part of such strategies, we should find a variety of site types produced during butchering, weapons maintenance and normal sleeping and eating activities. Discernible degrees of inter-site (or, in this case, inter-floor) variability are anticipated, as site types (residential bases, locations, field camps, stations and caches) vary or occur in combinations.

Following the temperature gradient model proposed in Chapter 11, we would expect that Hardaway-Dalton and Palmer (Lamella 16 through 12/11) occupation floors would be characteristic of logistically organized collector groups. Relevant archeological site contents of those floors should thus include: discrete activity areas with recurrent tool combinations; limited sets of curated tools for hunting-related activities; and, variable characterizations of site (or floor) occupations, e.g., residential bases, field camps, etc.

Residential/Forager Systems — cultural responses to more mature ecosystems with homogeneous resource distributions have been identified as fine-grained. Expected subsistence-settlement activities should be generalized and situationally responsive, rather than anticipatory. Activities will involve generalized tools and tool groups and the variety of site types will be few and hard to differentiate on the basis of associated assemblages or internal structure. An emphasis on plant, rather than animal, resources is predicted, so the nature of foraging activities will produce generalized internal site structuring with large numbers of expedient tools. Short term occupations by whole family groups should be characteristic. Reuse of any particular locus may or may not occur, but superimposed occupations would be difficult to contrast on the basis of assemblage differences or variations in the use of physical space.

Occupation floors identified as Kirk/Bifurcate through Morrow Mountain (Lamella 8-3) should be identifiable as products of residential/forager groups, according to the proposed model. Archeological remains on those floors should include: amorphous distributions of artifacts with variable combinations of tool forms; a variety of expedient tools (mainly flake tools) used for generalized activities of cutting, slicing, shredding, etc.; and low variability between successive occupations in terms of internal site organization.

Post-Morrow Mountain use of the Haw River sites (i.e., Late Archaic Savannah River and the several Woodland occupations at 31Ch8) cannot be easily characterized within the constructs of the temperature gradient model. That is, later Archaic and Woodland groups may not have been as constrained by the factors of resource structure as earlier Archaic groups and so do not "fit" the model, as presented. Instead, and as anticipated in Binford's (1980) discussion, other factors such as establishment of group territories or smoothing-out of resource incongruities through shifts toward food production (i.e., horticulture) may have acted to restrict group mobility, eventually influencing those post-Middle Archaic systems to become more logistically organized. Assuming that to be the case, we would further argue that Late Archaic and Woodland settlement and technological patterns will more nearly resemble logistical-collector systems than residential-forager types. Generally, the same set of expectations derived for Early Archaic Hardaway-Dalton and Palmer site organization patterns should apply.

The final interpretative goal of this chapter thus is clearly one of comparing the archeological data at the Haw River sites against these general expectations. This will be facilitated by summarizing several of the salient measures of assemblage composition and spatial organization within each floor:

Site	Floor	Curated tool/ Expedient tool ratio	Grid Optimum Size	r	Curated tool pattern	Expedient tool pattern
31Ch8	S.1	2.7:1	2 x 2	*	random	random
31Ch8	S.2	5.1:1	3 x 3	—	clustered	random
31Ch8	S.3	5:1	3 x 3	—	clustered	random
31Ch8	S.4	2.3:1	2 x 2	—	clustered	random
31Ch29	L.3	1.7:1		—	clustered	clustered
31Ch29	L.5/4	1:1		—	clustered	clustered
31Ch29	L.7/6	.80:1		—	clustered	clustered
31Ch29	L.8	1.05:1		*	clustered	clustered
31Ch29	L.12/11	.84:1		*	ambiguous	clustered
31Ch29	L.14/13	.63:1	>1 x 1	*	random	clustered
31Ch29	L.15	1.16:1	>1 x 1	—	clustered	clustered
31Ch29	L.16	1.50:1	1 x 1	—	random	clustered

Using this summary table we can examine the statistical compilations for artifact data from the earliest Hardaway-Dalton and Palmer floors at 31Ch29 through the most recent Woodland floors at 31Ch8. Definite, discrete activity areas are lacking for the lamella 16 floor, possibly due to the low recovery rate for tools of any type from that Hardaway-Dalton zone or, of course, due to sampling error in placement of the excavated block. Subsequent Palmer floors showed only slightly more pronounced clustering of tools, especially in the lamella 15 — Palmer I zone. Clustering was most consistent among expedient tools; curated tools were not necessarily clustered at each scale of analysis. Curated and expedient tools were spatially congruent to some extent in the upper 2 of 3 Palmer zones (Lamellae pairs 14/13 and 12/11). Some variability in the degree of clustering within and between curated and expedient tool classes can be explained within the generated set of expectations by identifying those levels as successively different functional site types or combinations of site types within basically the same overall logistical system.

Curated tools were commonly found on those floors, but only occasionally form small groups that might be interpretable as tool "kits," used for hunting and butchering-related activities (Goodyear 1974). Curated tools do not however, dominate these Early Archaic assemblages with the possible exception of the Hardaway-Dalton zone. A curated to expedient tool ratio of 1.5:1 for that level is noticeably higher than other Early Archaic occupations. Not until the Morrow Mountain period was that figure surpassed at this site, and it is highly likely that expediently fashioned tools (identified in Chapter 9 as "situational gear") functioned as a more integral part of collector group technologies than the general model suggests. Certainly, they consistently show a greater degree of clustering on the defined occupation floors. Problems with the spatial interpretations of these data, of course, may lie with our gross analytic categorizations of artifacts as either curated or expedient.

On the whole, then, statistically derived patterns of artifact discard in the earliest Archaic levels at 31Ch29 tend to conform to our expectations only in certain instances. Modelled predictions that distributions of curated tools would mirror discrete task events were confirmed only for Palmer I and, possibly, Palmer III occupations. On the other hand, expedient tools clustered in all four Early Archaic zones. While not specifically anticipated within the general framework of the model presented here, those situations did receive some emphasis in the detailed artifact analyses included in Chapter 9. A number of factors which undoubtedly have colored our interpretations have been recognized including sampling errors and mis-categorization of functional artifact forms.

Beginning with the Lamella 8 — Kirk I/St. Albans occupations at 31Ch29 we began to clearly recognize that two or more occupations had occurred on each surface. Some of the typological and geomorphological reasons for our conclusions have been presented earlier in Chapters 7 and 9. Increased total numbers of tools used in the spatial analysis from Kirk levels upward might reasonably be attributed to several episodes of site use, with obvious consequences for interpreting their distributions in space. The extended time span involved between the earliest defined Kirk and later, Morrow Mountain occupations (about 4000-5000 years) must likewise be identified as a potential source of error for attempts to characterize series of dynamically changing cultural systems as simply "residential-foragers."

What we can observe from the spatial analyses, however, is not an abrupt shift from logistical to residential site patternings at a hypothesized "flux point" somewhere between Palmer and Kirk/Bifurcate times. Instead the data can be interpreted within the framework of our general expectations as reflective of a gradual tendency for Archaic systems to exhibit the predicted characteristics, *culminating* in a very obviously residentially-mobile, situationally-responsive system by Morrow Mountain times.

In support of these contentions, we can examine the spatial data presented in this chapter. Beginning with the Kirk and Bifurcate (St. Albans and LeCroy) occupations of Lamella 8 and 7/6, we recognized the continuing internal organization of site space and probably activity zones which was common to the earlier Palmer levels and contrary to an expectation of more immediate random artifact distributions. This is witnessed by clustering of both curated and expedient tool categories.

To a notable degree, that tendency for some spatial organization continues on through the Middle Archaic levels of lamella 5/4 and 3 but has a somewhat different character. The prediction that expedient tool forms should predominate in assemblages from forager groups does not hold true any more than the converse situation for collectors (see above). Of course, the use of assemblage compositions to identify cultural systems which, in turn, should define the nature of the archeological assemblages they produced must be admitted as a possible example of circular reasoning. As we moved through time into Morrow Mountain occupations of 31Ch29 it was clear that expedient tools were forming their own clusters, separate from curated forms. Those situations are perhaps indicative of an emphasis throughout the sequence on activities requiring only situationally produced flake tool assemblages; the light duty slicing and cutting functions associated with forager group processing of small game or vegetable foods would constitute pertinent activity sets.

It thus appears that in a larger, temporally-progressive sense, the Archaic occupations of 31Ch29 following the earliest Hardaway-Dalton and Palmer zones can be viewed as adhering to the expectations for site formation within the definition of residentially mobile, foraging hunter-gatherer groups. Factors such as yearly, seasonal variability in settlement patterns and short term fluctuations in resource availability no doubt influenced those and all other occupations, constituting one more potential source of bias in our observations.

Earlier arguments for Late Archaic and Woodland stage tendencies toward logistically-organized adaptive systems also can be examined in terms of spatial arrangements of artifacts. For the Haw River sites, that of course involves scrutiny of the lithic and ceramic assemblage data from 31Ch8. The problems with defining occupation floors at that site were detailed in Chapter 9, but basic patterns of spatial arrangement nevertheless have been presented in the current chapter.

An element of those latter assemblages that should be emphasized concerns the relatively high frequency of curated to expedient tool forms within each stratum. Although multicomponency and sampling biases have influenced our perceptions, definite arrange-

ments were observed in all strata, except for the uppermost, for curated tools (and ceramics), while expedient tools were consistently randomly distributed. Frequencies of curated tools also were uniformly high relative to expedient forms with curated to expedient ratios always much higher than for any Archaic assemblages at 31Ch29 where a consistent ratio of nearly 1:1 was maintained throughout the occupation sequence. An exception ot the latter observation has been noted for the Hardaway-Dalton component.

If our assumption that curated tools are more characteristic of logistically organized systems holds true, then the Late Archaic and Woodland levels at 31Ch8 might be viewed as more "logistical" than the Early Archaic Palmer occupations at 31Ch29. However, we contend that the observed artifact ratios of 31Ch8 are products of highly organized systems responding to factors other than strictly environmental constraints. What we have possibly sampled are structured secondary refuse disposal areas for both lithics and ceramics and not necessarily activity areas *per se*.

It is hoped that the present interpretations of artifact spatial organization at 31Ch29 and 31Ch8 have elucidated certain of our points regarding diachronic variations in site usage. Statistical treatment of the data can of course provide the most easily defensible means for recognizing patterns, while interpretation in terms of larger archeological questions remains a difficult task. Much like the derivation of information on the complex production and life history staging of individual artifacts presented elsewhere, this section should impress the need for accurate, detailed recording of data sets that might initially seem trivial. An unswerving emphasis on recovery of only "diagnostic" tool forms should be abandoned, in favor of regarding all artifacts as potentially informative for the derivation of meaningful statements on archeological site formation processes and cultural-environmental interactions.

CHAPTER 13
SUMMARY AND CONCLUSIONS

The Haw River site group, including 31Ch29 and 31Ch8, represents one of the most important archeological information sources in eastern North America. Evidence of changes in human behavioral and environmental systems during the last 10,000 years is preserved at the sites, as a complex array of natural and cultural materials. The investigations reported in this volume comprise an effort to recover as much available data from those sites, prior to their inundation by the B. Everett Jordan Lake. Excavation and analysis of those data since 1979 constitute an intensive cultural resource management project, matching in scale the great potential of the sites. Several significant contributions to American archeological method and theory have resulted and will be briefly recounted in this final report chapter.

On the most obvious level, mitigation excavations at the Haw River sites provided an opportunity to reevaluate and, in many cases, reconfirm existing interpretations of Southeastern prehistory. The typological and temporal frameworks derived by other researchers like Broyles (1971), Chapman (1975, 1976) and, especially, Coe (1964) have been demonstrated to be consistently sound. Their general utility for placing artifacts into valid cultural-chronological frameworks has been accepted and bolstered by the Haw River findings. In terms of traditional archeological research goals, the work detailed in the present volume also reemphasizes the value of deeply-stratified sites for contributing to the clarification of problems endemic to regions like the Piedmont, where most sites are mixed surface deposits of artifacts with few obvious spatial or temporal relationships.

The major accomplishments of the Haw River project, however, derive from the overall intent of the project researchers to direct inquiries along more current lines of theoretical and methodological importance. An innovative model for explaining prehistoric behavior patterns has been developed and used to guide many of the evaluations and interpretations included in the report. The model incorporates a pronounced reliance on general ecological theory for structuring the ways in which archeological manifestations of artifacts, sites and settlement systems may be explained.

Interactions between variable natural resource structures and adaptive human cultural systems are emphasized by the model, which provides mechanisms for understanding diachronic patterns in material culture that transcend more traditional investigative frameworks. Rather than simply attributing variations in tool morphologies or assemblages to vaguely defined notions of stylistic change, we have instead attempted to better define technological systems as purposeful responses to changeable, governing environmental conditions. Strengthened by recent advances in ethnographic (or ethnoarcheological) and paleoenvironmental studies, this report is an attempt to redirect the thinking processes of archeologists toward some recent, if untested methods for explaining the archeological remains of hunter-gatherers.

On a purely methodological level, that research orientation has been applied to the Haw River data base through construction and implementation of a comprehensive lithic analysis program. Surviving cultural remains of stone tools and by-products have been treated in a manner that seeks to explain relationships between various functional attributes, manufacturing trajectories and life stages. With confirmed typological and chronological studies of other archeologists as a base, we have been permitted to explore the variability inherent in stone tool assemblages which reflects long-term changes in technological adaptive strategies.

Similar functionally-oriented studies have been performed for Piedmont ceramic assemblages using Haw River site information. Analysis of more typically stylistic or morphological elements of pottery wares has been combined with detailed study of ceramic technological elements like clay mineral composition, firing temperatures and the like. Application of powerful statistical tests to those combined data has permitted defensible reevaluations of current typological constructs for Piedmont ceramics.

A further application of statistical reasoning has involved treatments of the spatial arrangements of various lithic and ceramic tool categories from several occupation zones of the two sites. Interpretations of static and changing site organizational patterns relate directly to the larger stated research goals of explaining prehistoric human behavior.

The close cooperation between archeologists and geomorphologists marks the Haw River investigations as true efforts at interdisciplinary study. Full-time participation by geoarcheologists in the planning, execution and evaluation phases of the project has provided more meaningful results than could have been obtained by archeologists alone. Detailed studies of artifacts and soil sediments have facilitated interpretation of cultural materials using geological data as well as permitting interpretations of geomorphological and paleoenvironmental changes in the Haw River environs with accurate archeological dating controls. Close interaction between the two disciplines was an extremely important factor for the derivation of models for both archeological and geoarcheological interpretations. Data on paleoenvironmental changes were crucial to formulation of the hunter-gatherer settlement-subsistence model, just as artifactual information permitted important reconstructions of sedimentological regimes. New understanding of site formation processes and potentialities is a major contribution of those efforts and provide more accurate interpretive frameworks for archeological sites throughout eastern North America.

Chapter 2 of this report introduced several substantive research problems to be addressed during the Haw River data recovery and interpretation program. Major topics dealing with site formation processes and cultural-environmental interactions have been stressed throughout the body of this report. Four more topical problem areas were also defined, which will be briefly summarized within the present chapter. Specifically, they deal with: 1) recovered evidence for an Archaic to Woodland stage transition at the Haw River sites; 2) clarification of Woodland ceramic chronologies; 3) Bifurcate tradition occupations of the Haw River sites in particular and the North Carolina Piedmont in general; and 4) development of a theoretical model for explaining changes in prehistoric cultural systems of the Piedmont.

NATURE OF THE ARCHAIC-WOODLAND TRANSITION

Chapter 2 provides a summary of our interest in addressing the question of the enigmatic Late Archaic to Early Woodland transition, using available data from the Haw River sites. Clearly not an exclusive Piedmont phenomenon, the exact nature and timing remain undefined for an adaptational change from purely hunting-gathering economies to those producing food (at least on limited scales), utilizing ceramic containers and participating in various modes of burial ceremonialism. Unlike other portions of North America, however, where real "transition states" have been shown to exist archeologically, the real or imagined presence of a cultural hiatus between Archaic and Woodland occupations in the Piedmont remains a persistent research question.

As discussed in Chapters 2 and 3, several things influenced us to expect to be able to address this question at the Haw River sites. The specific riverine location of the site(s) was known to be a major factor conditioning the location of other Late Archaic and Woodland sites elsewhere in the Piedmont. Previous survey and excavation programs within the Jordan Reservoir area had demonstrated the presence of Savannah River Archaic and Badin (Woodland) artifacts on several sites in the immediate environs. Thirdly, excavations conducted specifically at 31Ch29 had produced minor evidence of Badin and Savannah River materials of that single site, but without exploring the possible relationships between those two site components.

Two major lines of evidence were eventually produced at the Haw River sites which support our contentions that a real transition does, in fact, exist. Immediate concerns for deriving information on earlier Archaic components led to the mechanical removal of soil layers containing most Woodland and Late Archaic deposits at 31Ch29 (Chapter 4). Given that situation, and faced with certain other exigencies, our decision to excavate Blocks B and C through all cultural levels present at 31Ch8 fortunately provided us with excellent data for addressing this and other research questions.

In addition to the planned analysis of lithic assemblage data from 31Ch8, additional effort was made to fully evaluate the significance of recovered ceramic artifact data from the same proveniences. The two distinct, yet complementary forms of evidence that reflect the transitional nature of Late Archaic and early Woodland occupations of the site thus include ceramic and lithic artifact data.

Both technological and typological studies of the 31Ch8 ceramic assemblage have been performed and are presented in Chapter 10. A stated central concern of those efforts included treatment of the temporal placement of the New Hope ceramic series within a cultural-chronological sequence for the Jordan Lake region. In addition, it was demonstrated through analysis of sherd attribute combinations and stratigraphic associational information that not only were recognizable earlier Woodland Badin-like ceramic forms present in the site deposits, but that perhaps "pre-Badin" wares could also be documented. The later Badin, Yadkin and other ceramic types were found in occupation zones associated

with several varieties of temporally diagnostic projectile points. However, the earlier ceramics found in Block B levels were definitely associated with lithic tool forms that otherwise would be identified typologically as Late Archaic, suggesting a relationship with transitional and Early Woodland stages of the Eastern United States.

Examination of the stone tool assemblages from 31Ch8 was directed primarily at describing and explaining continuities or changes in technological systems. Complex associational and stratigraphic placements for many of the later Archaic and Woodland forms found at 31Ch8 hampered clear definition of adaptational patterns in regards to the ecologically-oriented hunter-gatherer subsistence model considered for earlier Archaic materials at 31Ch29 (Chapters 9 and 11). Nevertheless, formal and functional evaluations of the 31Ch8 assemblages demonstrate both significant similarities and divergences from expected typological and comparative chronological frameworks derived from other Piedmont site excavations.

Combination of the recovered assemblages of Blocks B and C yield a fairly straightforward typological continuum from Early Archaic through later Woodland times in terms of "diagnostic" hafted biface forms. In addition to the expected forms, however, were discovered important numbers of point forms that has previously been unrecognized (at least in the literature) for Piedmont sites. Several identified forms are definitely non-typical of established Piedmont archeological sequences for the Late Archaic and Early Woodland substages, including several small stemmed, small lanceolate and notched varieties of projectile points (Chapter 9).

At least two possibilities suggest themselves for explaining the presence of such tool forms, even in obviously mixed archeological contexts. Typologically, the several varieties of small stemmed, notched or lanceolate points may represent transitional forms between the hafted point forms of Archaic stage assemblages and the commonly recognized triangular examples of Woodland stage groups. It was also argued that at least one point configuration, the rudimentary or contracting-stem variants, might represent a continuation of point design begun in the Middle Archaic substage of 6000 to 7000 years B.P. which persisted into the Woodland period.

A second, but not uncomplementary, interpretation for the presence of "aberrant" point types at 31Ch8 is that they represent supplemental tool forms, i.e., true projectile points, that were used in conjunction with more typical Late Archaic Savannah River Stemmed bifaces. This latter interpretation also serves to substantiate contentions of researchers who have maintained for some time that the large broad-bladed Savannah River points more probably served as hafted knives rather than spear or dart points.

Acceptance of either hypothesis permits reasonable modification of the notion that a typological, much less cultural, hiatus existed between Late Archaic and Woodland stage adaptations in the Piedmont. A recognized transition should be regarded as just that; no

abrupt shifts in technological organization or cultural development can be discerned. Gradual adoption of certain traits such as ceramic usage or particular lithic artifact styles should be accepted as an archeological reality, rather than adherence to an indefensible position favoring migrations or other cultural disruptions.

HAW RIVER CERAMIC PATTERNS

Several patterns through time may be noted in the technology of Haw River pottery from sites 31Ch8 and 31Ch29. These patterns summarize information gathered from technological and statistical analyses of Haw River sherds. It should be emphasized that there are exceptions and qualifications to any of the generalizations presented below, and that these suggestions should not be construed as referring to rigid and deterministic trends. Neither a uniform trend to better pottery nor uniform improvement in technological sophistication is strongly indicated by examination of the pottery. However, as noted with regard to clay sources, there appears to be a pattern of greater selectivity in choosing clay sources to obtain a desired final product.

The crumbly, sandy texture of the pre-Badin pottery (E; T-E; T-VI) suggests the use of easily available local resources: the exploitation of clay deposits in the immediate vicinity of the settlement would have meant a minimal expenditure of time and effort. These pots were of poor quality, but were evidently adequate for daily household use. Their character implies that no further investment of labor was considered worthwhile by aboriginal potters.

The succeeding Early Woodland ceramics (A, B, F, D; T-A, T-B, T-I, T-D; T-III, T-VI) show evidence of the deliberate selection of clays and inclusions to obtain a thinner, tougher, and more durable fabric. The addition of fairly large (3-4mm) aplastic inclusions which have been sorted by size and type suggests an attempt by early potters to control shrinkage and cracking so as to avoid the friable quality of earlier ceramics. The plasticity and workability of the clay allowed coil-forming rather than slab-forming and the possibility of larger, thinner vessels. Fractures along coil lines reflect one of the weaknesses of this technique. Later Yadkin and Uwharrie potters apparently achieved better success in bonding the coils, as witnessed by the preponderance of fractures across coil lines.

Yadkin pottery (i.e., I, G; T-J, T-H; T-II) shows considerable mixture of clays, both primary and secondary, implying an attempt to control pottery quality by the selective use of several local clays and tempering materials. This shift in use of clay sources may be, in part, a reflection of the changing location of settlements at this period, as well as an increased selectivity in the use of raw materials. In either case, it seems that potters were compensating for deficiencies in individual clays by mixing and tempering the available clays.

Uwharrie pottery (J; T-C; T-I) probably makes use of the same clay sources and aplastic materials, but represents a general improvement in techniques of working with these materials, e.g., crushing quartz and selecting temper size to compensate for shrinkage. The typical fabrics of this period are the outcome of better clay mixture and processing, and greater success in reducing shrinkage by the appropriate addition of aplastic materials.

The late proto-historic and historic pottery (H, C; T-F, T-G; T-IV, T-V) is clearly thinner and tougher than previous ceramics and illustrates both an improvement in pottery technology and the selection of better-quality clays of relatively limited distribution. The greater hardness of these vessels is related to a greater degree of vitrification which may have been produced by higher firing temperatures in a reduced atmosphere. Coil marks are not evident, indicating a greater facility in forming techniques, the use of better clays, and improved firing techniques. A general increase in strength and durability of these ceramics means that larger and thinner vessels could be produced.

The problem of Haw River ceramics designated "New Hope" may be examined in the context of the data presented above. Initial definition of the New Hope series by Smith (1965) focused on the attribute "presence of feldspar inclusions." Consideration of the geological determinants of local clay sources suggests that feldspar is a ubiquitous component of these clays. As such, feldspar inclusions in prehistoric pottery from the Haw River area of the B. E. Jordan Reservoir is predictable. Temporal assignment of New Hope pottery, if defined on the basis of aplastic inclusions, in thus a difficult task. A spatial designation relating to geological zones is perhaps more meaningful; however, the wide extent of feldspar-containing deposits in Piedmont North Carolina compromises the merit of any such spatial category. From this perspective, a comparison of ceramic profiles from south of 31Ch8 and 31Ch29, i.e., south of the junction of the Haw River and New Hope River would be instructive since the New Hope River drainage is geologically distinct from the upper Haw River drainage.

Broader, more rigorous consideration of technological aspects of Haw River pottery in this study allowed clear delineation of ceramic variability. Six major technological themes have been documented. These technological data have been substantiated by multivariate statistical investigations of the pottery. Explicit definition of ceramic attributes produced replicable statistical patterns of covarying traits. Importantly, these statistical patterns agreed well with established categories of prehistoric pottery in the Piedmont. By reference to these, and other data, it is possible to report a series of aboriginal occupations at 31Ch8 and 31Ch29.

The first occupation of 31Ch8 by peoples possessing ceramic skills is evidenced by a relatively crude, sandy ware designated Technological Type VI, and Statistical Type E and T-E. This early, pre-Badin pottery occurs in stratigraphic association with late Archaic lithic artifacts. The Late Archaic period was indicated by both morphological traits of projectile points and C-14 dates.

Occurring after this initial ceramic type are several pottery categories which may be associated with Early Woodland cultures. Variation in these earlier Woodland types ranges from ceramics reminiscent of the pre-Badin pottery to typical Badin wares to vessels of a more generalized Badin/Yadkin nature. This variation suggests repeated, if irregular, occupation of the area prior to A.D. 500.

Middle Woodland occupation of the Haw River site 31Ch8 is indicated by Vessels III and IV. These ceramics may be considered areal variations of Yadkin pottery. The technological attributes of these vessels suggest subtle, as yet ill-defined, behavioral differences from preceding cultures.

Uwharrie period occupations in the Haw River Reservoir are well documented (McCormick 1970; Wilson 1976). Site 31Ch29 produced extensive evidence of Uwharrie artifacts. The relatively limited number of Uwharrie artifacts recovered from 31Ch8 are probably associated with occupations at 31Ch29. Uwharrie pottery from both sites appears common in character to Uwharrie pottery from other areas of the Piedmont.

A final series of late, proto-historic and historic wares document several distinct, probably brief episodes of occupation at 31Ch8 and 31Ch29. Although no paradigm Pee Dee ceramics were recovered from these two sites during the 1979 investigations, Vessel I/ Technological Type V is interesting in its "sugary" appearance. Direct assignment of this ware to established ceramic categories is difficult; however, given the local variability of late prehistoric pottery, this is not entirely surprising. Further information about this vessel might emerge from more detailed determination of the geological source of the aplastic inclusions — there is some hint of non-local origins for the quartz sand appearing in Vessel I.

The last evidence of aboriginal cultures at sites 31Ch8 and 31Ch29 is seen in ceramics which correspond to the Hillsboro category. No Colonial, e.g., wheel-turned or glazed, pottery is present in the collection of artifacts from these sites.

BIFURCATE TRADITION OCCUPATIONS AT 31Ch29

The Haw River sites (31Ch29 and 31Ch8) in north central North Carolina contain a complete stratigraphic record from late Paleo-Indian through protohistoric times. Like the Hardaway, Doerschuk and Gaston sites investigated by Coe, they provide a unique opportunity to study long-term changes in cultural systems. Repeated reoccupations at this single location allow us to monitor technological responses to significant environmental fluctuations during the course of the Holocene.

Previous chapters have discussed the natural and cultural factors influencing the archeological record at Haw River. Reconstructions of effective paleoenvironments and factors influencing alluvial deposition/preservation of the sites' contents have been presented. Effective environments also have been considered in terms of a model of hunter-gatherer settlement-subsistence patterns and technological organization.

This section will accomplish three things:

1) Note the presence of significant occupations by Bifurcate horizon groups in the Piedmont, as anticipated by Jefferson Chapman. Prior to the Haw River excavations, Bifurcate materials had never been found in good archeological contexts outside the Appalachian mountain region, including Coe's Hardaway/Doerschuk sequence.

2) Use the Bifurcate occupations at 31Ch29 as a test case for illustrating the effects of environmental stress on cultural systems.

3) Provide several alternative hypotheses for the presence of Bifurcate horizon materials in the Piedmont Archaic sequence.

A concise history of the recognition of bifurcate base points as cultural markers has been provided by Chapman (1975). Beginning mainly in the mid 1950s (Kneberg 1956), those artifact forms have been identified as distinctive Early Archaic forms with a limited period of usage (ca. 700-1000 years). Several varieties have been named (Broyles 1971; Chapman 1975) and shown to have fairly restricted geographical distributions in eastern North America. Several stratified archeological sites in east Tennessee and West Virginia have produced alluvially-sealed deposits associated with distinctive Bifurcate varieties, including St. Albans, LeCroy and Kanawha. Excellent separation of the several type varieties has been found at sites like St. Albans and Rose Island, which has permitted accurate dating of the artifact forms (Chapman 1976).

Jefferson Chapman's study of Bifurcate tradition artifact and site distributions in eastern North American led him to hypothesize that their occurrences were somehow related to the prehistoric distribution of oak-hickory forests. Chapman interpreted bifurcate points as the last widespread Early Archaic horizon, in the same sense as earlier Dalton, Big Sandy and Kirk horizons defined by Tuck (1964). The final Early Archaic occupations were traced from the Fall Line of Georgia north to the Great Lakes, and from the Mississippi River east to the Atlantic Ocean. Chapman predicted that Bifurcate horizon materials would occur across the Piedmont region of North and South Carolina and onto the Coastal Plain, despite present evidence that suggests a lack of oak-hickory forest zones in the latter area.

A recent census of archeologists working in the Carolinas found that Bifurcate points are uncommon occurrences in the Piedmont, usually found in eroded surface contexts with other Early Archaic materials (Ned Woodall, personal communication 1980; Al Goodyear, personal communication 1980). Rarely do they occur on the Coastal Plain. Limited evidence from the Hardaway site and, now, from 31Ch29 shows that Bifurcate horizon occupations did occur with some frequency along the edge of the Piedmont, or fall zone, or *at least* have been found in sufficient density and under favorable conditions for their preservation and recovery.

The excavation plan at the Haw River sites was designed to recover data on deeply-buried, well-stratified Early Archaic components. Initial tests demonstrated the presence of Hardaway-Dalton, Kirk and Middle Archaic Morrow Mt. occupation zones, which were subsequently recorded through large-scale block excavations. A very surprising addition to those site elements was the discovery of two occupation zones producing Bifurcate tradition St. Albans and LeCroy materials. Found in correct stratigraphic sequence between earlier Kirk or Palmer and later Morrow Mt. floors, those occupation floors mark the first instance of *in situ* recovery of Bifurcate remains from the Piedmont. A single radiocarbon date of 7960 ± 90 B.P. (Beta-1367) from the top of those zones confirms their chronological and stratigraphic integrity.

Morphologically, the Bifurcate tradition artifacts at 31Ch29 duplicate examples found elsewhere by Chapman, Broyles and others. The total lithic tool assemblage from the Haw River occupations differs markedly, however, from those found in east Tennessee and West Virginia. The most obvious difference includes a lack of bipolar lithics at 31Ch29, which may indicate a variation in raw material accessibility as much as a technological element. Ground stone tools of all types are lacking as well from the Haw River deposits, as are the preserved floral remains of the Rose Island Site.

The occupation floors at 31Ch29 which yielded evidence of Bifurcate tradition occupations also contained artifact forms which most nearly resemble later Kirk phase materials common to the Piedmont. At the Rose Island and St. Albans sites, Bifurcate varieties were found in one meter or more of well-defined, discrete stratigraphic layers. The Haw River situation includes all bifurcates and associated Kirk forms within 20-30 cm of deposits. Common earlier and later Archaic materials were found in thicker bands of alluvium and differ markedly in that respect from the east Tennessee and West Virginia sites. A decreased deposition of alluvial materials along the Haw River can thus be recorded for the period from 7000 to 6000 B.C. Several occupations took place on the exposed terrace surfaces, including at least two Bifurcate and two Kirk phase occupations.

Interpretations of Bifurcate tradition data by Chapman concluded that they represent part of a logical typological continuum from late Paleo-Indian to Middle Archaic tool forms. As the Haw River data indicate, certain real trends in tool morphology are evident between those Early to Mid Holocene forms. It is our contention that the evident changes in tool morphology reflect more than simple stylistic variability. Instead the Bifurcate tradition artifacts at 3lCh29, in conjunction with the geoarcheological interpretations of the sites' depositional history, point to the beginnings significant cultural and environmental shift at ca. 9000 years B.P.

Early Holocene Hardaway-Dalton and Palmer artifact assemblages, described in Chapter 9, have been interpreted as technological elements of logistically-organized collector hunting groups. Due to their hypothesized adaptational patterns which favored maintenance or curation of specialized lithic tool assemblages, it was argued that those items

should reasonably exhibit pronounced degrees of within-class uniformity in design and maintenance patterns. Hafted bifaces in particular (but also other bifaces, endscrapers, adzes and flake tools) were shown to have been produced, used, reconditioned and discarded within narrow constraints. Real continuities of tool production and use have been demonstrated that otherwise might be dismissed as minor stylistic or morphological changes within technological systems that persisted for 2000-3000 years.

A parallel conservatism in lithic tool design was illustrated for Middle Archaic assemblages, particularly the Morrow Mt. biface types, that probably persisted well into Late Archaic or even Woodland times (Chapter 9). Despite very basic changes in environmental regimes which conditioned a transition to foraging-based economies, the archeological remains of Middle Archaic groups left at the Haw River sites show a remarkable consistency in modes of tool production. Expediency rather than maintenance potential was stressed, especially for less formalized categories of unifacial flake tools. Nevertheless, tool kits characteristic of those Middle Archaic groups show uniformities in production trajectories that at least equal the continuities present in Early Archaic assemblages.

The period intervening between Early Archaic Palmer and Middle Archaic Morrow Mt. phase occupations of the Haw River locale has been shown to coincide archeologically with Bifurcate and later (terminal ?) Kirk occupations. The lamellae 5/4 occupation zones described in detail in Chapter 9 produced a miscellany of artifacts, especially hafted bifaces, which are characteristic of final Early Archaic site components present also at sites like Rose Island (Chapman 1975, 1976). Discussion of the morphological elements of those tools has noted the trends in design and modification of elements like blade shapes, haft element treatments and biface production modes that indicate continuities between Early Archaic Palmer forms with comparable Bifurcate and Kirk artifact types. *Within* the assemblages from the Bifurcate/Kirk Corner-notched horizons, however, exists a great deal of variability in tool morphologies.

During an accepted time span of 700-800 years for Bifurcate and Late Kirk occupations, a discerned pattern of increased tool diversity and accelerated experimentation with novel design elements (like basal bifurcation) can be demonstrated, in concurrence with purposeful selection of high grade raw materials and other techniques intended to enhance tool longevity (blade serration) (Goodyear 1979). All of those technological decision processes are interpreted as reflecting either increased mobility or other cultural responses to a period of environmental stress.

The marked variability in tool design during Bifurcate occupations of 31Ch29, and perhaps the entire Piedmont, is argued to coincide with the beginning of the Altithermal or Climatic Optimum in the Southeast. Increased desiccation (decreased precipitation) and changes in vegetation definitely affected the alluvial deposition record, as detailed in Chapter 6 of this report.

Variability in tool designs of both the Bifurcate and co-occurring Kirk occupations at 31Ch29 is felt to mirror this period of environmental stress. As new vegetation and game patterns developed at the end of the Early Archaic substage, settlement and technological systems likewise evolved. Experimentation with new tool forms and attributes was the result, as well as obvious attempts to retain older forms, as long as they performed necessary tasks in an efficient manner.

Alternative hypotheses may be presented to account for the Bifurcate occupations at 31Ch29. As Holocene environmental changes affected mobility patterns of Archaic stage groups, they may have somehow forced population transmigrations from more mountainous western regions into the Piedmont. A lack of sites in intervening areas with substantive Bifurcate occupations, *and* the distances involved, may be cited as potential arguments against that case.

A second hypothesis, that Bifurcate points are alternative tool forms within a basic Piedmont Kirk stylistic or technological tradition is also possible. Recovery of both types from the same occupation floors, occasionally made from identical raw materials, lend credence to that argument. Adequate treatment of the problem would require recovery of larger samples of artifacts and very detailed edge wear studies to determine if, in fact, the several biface forms were serving in identical on disparate functional roles.

The favored hypothesis centers on Archaic tool forms as reflections of technological adaptations. As predicted by Chapman (1975), Bifurcate remains are present in correct stratigraphic sequence in the Piedmont. Beyond merely a stylistic element, however, they are felt to represent substantial evidence for cultural adaptations to a period of environmental stress. Tool elements were designed to facilitate high maintenance potential and prolong use-lives, under conditions of high mobility, while incorporating variability needed for successful adaptations to relatively rapidly changing environmental conditions. Exact tracing of the development of point base bifurcation or separation of Bifurcate from Kirk variety points may not be so germane to this argument, as was true of the two preceding hypotheses. Instead, the variety of points and other tools assignable to Bifurcate and late Kirk occupations, found in stratigraphically thin occupation zones at 31Ch29, are viewed as material reflections of a short-lived archeological phenomenon at the limits of a predicted ecological range.

DEVELOPMENT OF A PREHISTORIC SETTLEMENT-SUBSISTENCE MODEL

A basic organizational element of this report has been an explanatory model of cultural adaptive patterns outlined by Lewis Binford (1980). He has proposed that the variations observable among settlement systems of ethnographically documented hunter-gatherer groups may be correlated with global ecological patterns of effective temperature and, secondarily, the distributions of faunal and floral resources. A dichotomy between what are termed collectors and foragers has been postulated by Binford for hunter-gatherers, reflective of their subsistence orientations toward incongruent (collector) or congruent (foragers) resource structures.

Cultural systems exhibiting characteristics of one or the other of those economic modes are further identified as to group mobility patterns employed to effect adaptations under variable conditions of climate and resource structure. Collector groups are commonly found in higher latitude situations, according to Binford, where extreme seasonality and overall low effective temperatures condition spatial and temporal incongruence of vital resources. Emphases are necessarily placed on hunting of herd animals or seasonal exploitation of unearned resources (especially anadromous fish).

The group mobility patterns of such collectors are termed *logistical* by Binford. They involve a highly organized system of group coalescence or dispersal into task groups as needed to obtain needed items of food, fuel and other raw materials. A complex array of functional site types has been listed for those systems, associated with various task group sizes and activities.

Group mobility patterns identified for forager subsistence types are called *residential*. Entire, usually kin-related groups are moved *en masse* to new loci of food or raw material occurrence as items are exhausted within daily foraging radii of base camps. Residential patterns are typically found in homogeneous environments, characteristic of lower latitudes. Resources there are evenly distributed and exploitable on a more casual encounter-type basis than is the case where items are scattered and must be obtained using logistical mobility patterns.

A more detailed presentation of Binford's model has been made in Chapter 11 of the report. Along with the discussion of subsistence and mobility patterns we provided supporting data and arguments for application of the model to archeological situations in North Carolina, especially those encountered at 31Ch29 and 31Ch8. This involved reconstruction of paleoenvironments from late Pleistocene through Holocene times which, we argued, influenced prehistoric systems in a time-transgressive sense much like the global latitudinal sequence for resource structures and associated cultural systems proposed by Binford.

What emerged from our attempts to apply the general constructs to specific archeological contexts is a hypothetical, temporally-ordered sequence of prehistoric mobility patterns from the Early Archaic through Woodland substages, as we were able to view them in terms of archeological remains of lithic tools, ceramics and site organization patterns. A temperature gradient model was developed to illustrate how changing climatic regimes from early to middle Holocene times may have influenced resource structure and, eventually, cultural adaptations. The idea was advanced that Early Holocene conditions of marked seasonality favored human adoption of collecting strategies and logistical mobility patterns. Archeological correlates for such behavior patterns were discussed, including site structures and assemblage compositions. Those expectations were eventually treated in light of the Haw River data base in Chapters 11 and 12.

In similar fashion, our theoretical model construction and projection to archeological data attempted to classify later Middle Archaic adaptations as foraging orientations with residentially-mobile settlement systems. The climatic elements identified as conditioning the gradual changes from earlier logistical-collector systems may be associated with the Altithermal or Climatic Optimum. Increasing temperatures with related decreases in precipitation (or, more likely, increased evapotranspiration) probably moved southeastern environments toward more homogeneous (congruent) resource distributions, which in turn influenced cultural changes. Development of foraging economies and residential mobility patterns were the result, and have been correlated with Middle Archaic (especially Morrow Mountain) occupations in the Piedmont. Specific archeological correlates identified in this study as representative of those changes include technological trends in production and maintenance of lithic tool forms. Composition of assemblages in terms of labor investment, i.e., the curated and expedient nature of tools, was considered, as were the spatial arrangements of those items on occupation surfaces.

Similar consideration in terms of this model has also been given to Late Archaic and Woodland stage data from site 31Ch8. Applicability of the temperature-gradient model to those periods was modified by our acceptance of other data which suggest that extra-environmental elements like establishment of group territories or the inception of food production possibly influenced group movements and subsistence economies lessening the influence of purely ecological factors. Nevertheless, we found that our data could be used to demonstrate limited, if imperfect utility of the model for characterizing changes during those later times.

Development and application of a unifying theoretical model to the Haw River sites thus has allowed uniform classification and interpretation of a diverse collection of archeological and environmental data from those sites. With a continuous, 10,000 year sequence of occupations at that one locus, we have been able to model long term, interrelated changes in both cultural and natural systems. From a regional perspective, this study can obviously serve as a body of heuristic theory (and methods) for making evaluative comparisons among other sites in the Piedmont and Southeast. Other potentially unifying constructs such as Caldwell's (1958) treatise or Cleland's (1976) "focal-diffuse" model have received some limited usage, mainly for interpreting artifact sequences or economic-subsistence patterns. What we have offered will supplement those ideas and extant typological schemes, while providing a framework for characterizing and explaining changes in material culture and human adaptational systems.

Sites like the Haw River group are rare occurrences in the Southeast, subject to vagaries of formation, preservation, exposure and modern land-use practices. We were presented with the opportunity to recover an important data set, which was subsequently used to develop and test a general model of human cultural adaptations. Our arguments merit further testing and consideration, of course, using regional survey and excavation information from other localities in the Carolinas and larger Southeast. Modifications of our ideas or even generation of new explanatory models should result, and will be welcomed.

The final contribution of the Haw River archeological program, however, lies beyond the realm of scientific inquiry. The expenditures of time and money it represents mark the project as a large-scale, well-coordinated effort between professional archeologists and Federal agency planners to deal with an endangered collection of significant cultural resources. Within very real limits of construction schedules and budgets, the Haw River site excavations stand as a well-orchestrated effort to provide meaningful scientific information from a salvage-oriented effort. The public interest has also been served, as even the more esoteric forms of information contained in this report have been preserved and can be made available for future generations.

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APPENDIX 1

SCOPE OF WORK AND AMENDMENTS

REVISED PROPOSAL 62-069-P19C

FOR

ARCHEOLOGICAL MITIGATION OF
IMPOUNDMENT ZONE SITES 31CH8 AND 31CH29
B. EVERETT JORDAN DAM AND LAKE, NC

PREPARED

FOR

U.S. ARMY ENGINEER DISTRICT
CORPS OF ENGINEERS
PO BOX 1890
WILMINGTON, NORTH CAROLINA 28401

BY

COMMONWEALTH ASSOCIATES INC.
209 E. WASHINGTON AVENUE
JACKSON, MICHIGAN 49201

AUGUST 3, 1979

MITIGATION RECOMMENDATIONS

INTRODUCTION

The investigation proposed herein is designed to satisfy the governing legislation listed in the basic Contract No. DACW 54-79-C-0020. This effort is intended to accomplish multiple research objectives by a multistaged research design that will constitute mitigation for the archeological resources investigated during Phase I of this contract.

OBJECTIVES

The research objectives to be attained by this investigation are chronological and behavioral in nature.

The following behavioral objectives constitute the major emphasis of this project:

1. The isolation of activity and community patterns within microstratigraphic units of the Early Archaic Kirk horizon at either 31Ch29 or 31Ch8.

2. The isolation of activity and community patterns within microstratigraphic units of the possible Early Archaic Hardway horizon at Ch8.

The chronological themes that constitute ancillary objectives are as follows:

1. Clarification of a Woodland ceramic chronology.

2. Resolution of the Late Archaic Savannah River and early Developmental cultural distinction.

3. Documentation of stylistic and technological changes in known point types through the Early and Middle Archaic.

4. Investigation of cultural-environmental interactions through time.

This scope of services excludes the excavation of any Paleo-Indian cultural horizons. These materials were not encountered during Phase I deep testing and they are not expected to be found. If encountered, the excavation of this earlier and deeper horizon will be the subject of a future scope of services.

FIELD METHODOLOGY

The field strategy is a combination of manual and mechanical excavation tactics to satisfy scientific, engineering, and safety requirements within a restricted time schedule while minimizing the impacts of flooding. The strategy involves techniques used in above-ground, open site and near eastern "tel" sites. The strategy also involves the use of ten 1m x 2m excavation units along with three major block excavations and backhoe trenching with qualitative and quantitative provenience controls. The maximum use of vertical profiles will be employed to detect and preserve microstratigraphic data. The outline of this strategy consists of the following eight major steps for a block to be located at 31Ch29.

1. The location of the major blocks will be determined on the basis of Commonwealth's backhoe testing and previous excavations (see Figure 1 for general location). Either site (Ch8 or Ch29) can be the location of the first block; the second block must be located in the other site.

2. Prior to major block excavation, a dewatering system of perimeter underground drainage will be deployed to carry subsurface water to external drainages. A lightweight fence will be erected to protect the site.

3. The upper 1m of soil in a 14m x 14m block centered upon the ultimate 12m x 12m block excavation will be mechanically stripped.

4. This smaller block will be mechanically stripped to the top of the Kirk Horizon. The depth to Kirk will be verified by examination of the drainage profile.

5. Approximately 25 percent of the Kirk horizon will be piece plotted by trowel excavation techniques, with all material greater than 30 mm in maximum dimension being point provenienced.

6. The remainder of the Kirk horizon will be shovel skimmed in these levels in an attempt to retain as much point provenience as possible to serve as the spatial

bases along with Step 5, for attaining the Kirk behavioral objective listed above. The materials from this shovel skimmed area will be collected in 1m x 1m units.

7. After the Kirk horizon has been removed, three backhoe trenches in each block will be excavated to test for the presence of Paleo-Indian materials in the profiles. This will be a reasonable effort restricted to the use of the underground drainage system and water pumps.

8. Flotation, soil, ecofactual, and pollen samples will be taken from excavated features and from other proveniences where necessary.

At 31Ch8, one major block excavation will be performed primarily for the purpose of attaining the Hardaway behavioral Objective 2, above. All the steps of the preceding outline will be followed with exceptions for stratigraphic and chronological differences from Ch29. A third block, or a portion of it, may be excavated at either Ch8 or Ch29 to recover an additional sample of either Kirk or Hardaway materials. This block may be located so as to avoid the recovery of redundant data, and to obtain the full range of artifact variability thought to be present at either site.

Ten 1m x 2m units will be judgmentally located to obtain samples of the Middle Archaic through Developmental periods. These units will be excavated to the base of the Middle Archaic horizon in arbitrary levels within natural stratigraphic units to attain the chronological objectives listed above.

It is estimated that the total proposed excavation will produce approximately 122,016 cultural specimens. This estimate is based on Wilson's (1976) deep test number 120R90 and is based on his actual changing artifact densities through time. Deviations greater than 15 percent from the above estimate will necessitate a renegotiation of the laboratory effort.

Flooding may cause the termination or delay of all or part of the field excavation. In the former case, when flooding may cause an early termination of the project at no fault of the Contractor, an equitable adjustment shall be arranged between the government and the Contractor. This prorated adjustment shall be calculated on the basis of the excavated cubic meters of soil relative to the total excavation effort and shall include a commensurate proportion of the laboratory effort. The calculation of the expended field and laboratory program shall allow for the effort necessary to initiate these activities.

Field delays and site damage at no fault of the Contractor may also be caused by flooding. This risk cannot be estimated and is not part of the enclosed cost proposal. The Contractor shall make a reasonable effort to minimize this risk by the drainage protection described in this proposal and by the plastic tarping of unexcavated areas when flood danger is imminent. Losses due to unproductive time caused by lack of access and/or inability to excavate shall be negotiated as a contract modification. The Contractor shall make all reasonable efforts to obtain access and to resume excavation following any unproductive time. The Contracting Officer's representative shall be advised whenever the Contractor determines that access or excavation is judged impossible, unsafe or otherwise unadvisable. Based on Corps of Engineers data, it is agreed that six days of unproductive time have been included in this proposal. The Contractor shall schedule the excavation in such a manner that no more than 300 square meters of surface area are open and unfinished at any given time.

ANALYTICAL DESIGN

The laboratory effort is designed to combine an analysis of the cultural specimens with a natural science component that will elucidate the cultural ecology of the major cultural occupations. The cultural dimension includes the spatial analysis of lithic and ceramic specimens, as well as the utilization of ecofactual specimens including floral and faunal specimens. The naturalistic component includes geoarcheological research as well as paleoenvironmental clues suggested by ecofactual data.

Laboratory analysis will be conducted both concurrently with fieldwork and in the Commonwealth Archeology Laboratory in Jackson, Michigan for several months beyond the fieldwork. The field laboratory analyses will include final washing (if necessary) and preliminary identification, sorting, and counting of lithics, ceramics, floral, and faunal specimens. This immediate assessment of data will provide an ongoing interaction between laboratory information, the research problem, and fieldwork progress. Other special samples will also be curated for subsequent analysis (e.g. floral, faunal, pollen, soils, carbon-14, etc.).

The Commonwealth laboratory analyses will involve cataloging, weighing, measuring, determination of utilization and preparation of artifacts for final curation. Special sample analysis will be coordinated and these various data

will be synthesized. The data set will be coded for computerization, and thus allow for various statistical descriptions, inferential tests, maps, and proper storage of the data with quick retrieval.

Specialized analyses will be performed with each major data category in an effort to attain each research objective stated above. The lithic analyses will focus in five areas: 1) the isolation of spatially segregable tool kits for those Kirk and Hardaway living floor data with point provenience; 2) an attribute-based stylistic analysis to trace the development of hafted biface forms with special emphasis on the Early and Middle Archaic; 3) analysis of the debitage in order to elucidate changing lithic reduction strategies through time (Goodyear 1974); 4) a source analysis of toolstones to be derived through a sampling-based thin sectioning program; and 5) a microscopic study of edge angle and edge wear to determine artifact utilization patterns (Wilmsen 1970, Semenov 1964).

The temporal placement of the New Hope pottery series recovered from the B. Everett Jordan Reservoir area is a problem that has not yet been resolved. Previous work by Smith (1965), McCormick (1970) and Wilson (1976) hypothesizes a Middle Developmental and/or a Late Developmental cultural affiliation. In order to clarify this confusing temporal placement question, an approach using multivariate analysis is proposed.

This ceramic problem will be addressed through a three-step program consisting of 1) a test for the independence of attributes, 2) a cluster analysis and 3) a quantitative seriation analysis. This program is based on the quantitative measurement and qualitative observation of ceramic attributes; Snavely (1976) refers to the latter as multistate nominal categories. The first step involves the phi-coefficient analysis which will serve as a preliminary screen to eliminate the attributes that are to be considered as dependent variables. This will be accomplished by a series of pair-wise, one-on-one comparisons among the various combinations of attributes.

The second step is the cluster analysis to identify those attributes within a cluster that can be used as diagnostic of that particular cluster. Any attribute that has a minimum percentage occurrence of 30 percent is considered as a potential diagnostic. The final evaluation will depend on the relative frequencies of other attributes in that cluster. The phi-coefficient is a necessary pretest because the cluster analysis assumes independence among the various attributes. Cluster analysis will be performed using the CLUSTAN program with an allocative modification called RELOC. Interpretation of each specific cluster will be determined by the percentage occurrence of the variables at various levels.

The third step will be the quantitative seriation of these data with site data from other Piedmont sites used by Newkirk (1978) and Barnette (1978), in order to place the sites in relative chronological order. This will be done by a nonmetric multidimensional scaling (MDS) which requires the assumption that time is the factor involved in the ordering of clusters (Barnette 1978:81). MDS ordering of the various ceramic assemblages will ideally order the clusters linearly along the temporal and formal dimensions. This will provide a good indication of the temporal placement of the New Hope pottery series in relation to other known Piedmont ceramic wares and to the stratigraphy of Ch29 and Ch8.

The objective of the geoarcheological investigations is to reconstruct the paleoenvironment and the depositional history of the site. This will be done by a microstratigraphic analysis of the site and by an analysis of sedimentological samples collected from the archeological excavations. The paleoenvironmental reconstruction will be augmented by the artifactual analyses of floral and faunal samples.

In addition to the major objectives outlined in the "Objectives" section, it is anticipated that certain more specific research problems will be addressed if the expected data are encountered in sufficient quantities during the outlined field strategy.

RESEARCHABLE PROBLEM AREAS

A multistage excavation and analysis program is proposed for mitigation of the Haw River sites. Close coordination of field laboratory and reporting phases will insure effective treatment of research problems peculiar to the New Hope/Haw River drainage and endermic to Piedmont archeology on a more general scale. Several questions have been raised by previous researchers at Sites Ch8, 28 and 29 and will be outlined here. These and other research questions discussed herein can be elucidated through careful excavation of stratified, _in situ_ cultural materials. A unique opportunity exists to deal with problems of cultural/chronological and processual nature for prehistoric occupations spanning at least the last 9000 years.

Five major areas of study are proposed, each dealing with one or more aspects of defined cultural stages or periods. The five problem domains concern the following:

1. Accurate identification and temporal placement of the New Hope ceramic series. This developmental (Woodland) ware was defined by Smith (1965:109) and further treated by McCormick (1970) and Wilson (1976). Concise chronological and spatial parameters have not yet been placed on its occurrence.

2. Consideration of the technological and cultural changes manifest in the Late Archaic/Early Woodland transition. Coe (1964) identified a stratigraphic hiatus between nonceramic and ceramic assemblages, which were interpreted as an equally abrupt cultural change (1964:124). Evidence has been accumulating to the contrary (Taylor and Smith 1978; Faulkner and Graham 1966) and merits confirmation or denial based on clearly stratified archeological data such as are present at Sites 31Ch8 and 29.

3. Several stylistic and technological changes occurred in Middle and Early Archaic lithic assemblages. Stratigraphic controls, combined with detailed metric attribute analysis, may help to explain some of the variance evident in formal tool classes - especially hafted bifaces ("projectile points").

4. Recent investigations of other deeply stratified sites in eastern North America have yielded firm evidence for intensive occupation of riverine environmental zones by Early Archaic groups (Chapman 1975, 1978; Gardner 1974; Goodyear 1974). Several problem areas concerning Early Archaic components at the Haw River site will be addressed, including definition of living floors; spatial segregation of functional tool assemblages; and finer control over stylistic/technological variations in hafted biface "types."

5. Paleo-Indian occupations in North American remain elusive, partially due to the time element involved and presumed low population densities. Any information that can be derived on pre-Archaic, Pleistocene utilization of the Haw River area will be valuable to Piedmont and North American archeology in general. Preliminary test excavations have revealed at least .5 m of cultural deposits below identified Early Archaic tool forms that may yield data on pre-Holocene cultural and ecological conditions.

The following section will deal with each of these questions in more detail. Effective treatment of the stated problems is, of course, contingent on recovery of pertinent data in a controlled interpretable manner as described in the "Field Methodology" section.

New Hope Ceramics

The temporal placement of the New Hope Pottery series recovered from the B. Everett Jordan Reservoir area is a problem that has not yet been resolved. This pottery series is similar to the Uwharrie series except for its tempering agent of feldspar and preponderance of plain sherds. Both Smith (1965:109) and McCormick (1970:80, 84-85) feel that the New Hope ceramics are a Middle Developmental ceramic series, based upon the replacement of sand tempering (Badin) by crushed feldspar (New Hope) which was then replaced by crushed quartz (Uwharrie). Wilson (1976:37) hypothesizes a Late Developmental Cultural Affiliation for the New Hope pottery based on stylistic evidence: 1) One piece of simple stamped pottery was recovered by McCormick (1970:80), an exterior treatment which did not appear in the Piedmont until very late. 2) The preponderance of plain ware in the New Hope series is an exterior treatment technique that did not become popular until the end of the Late Developmental, the Climatic and Historic periods. 3) The use of feldspar as a tempering agent appears to give the pottery a sugary appearance, a characteristic noted by Coe (1964:33) for PeeDee ceramics. One additional factor noted by Wilson (1976:40) is the obvious lack of Middle Developmental cultural material from the survey and or excavation of Ch29. Wilson states (1976:40) that in order to solve the temporal placement question of the New Hope pottery, ceramics have to be found in a stratigraphic context.

An alternative solution to the intuitive approach mentioned above is the use of multivariate analysis. Recent studies of North Carolina Piedmont pottery have utilized various computer techniques to analyze numerous ceramic assemblages resulting in a series of pottery types (Barnette 1978 and Newkirk 1978) which were then used to order the assemblages chronologically (Barnette 1978).

The "Analytical Design" section details the sampling and laboratory methods used to perform this ordering.

Late Archaic/Woodland Transition

Since the 1964 publication of Coe's seminal work on Piedmont archeology, various researchers have expressed reservations about the clear-cut definition of cultural stages presented in his book. One area that has escaped adequate explanation is Coe's assertion that Late Archaic tool assemblages "appear to have been replaced abruptly by large triangular points and well-made cord- and fabric-marked pottery (1964:124)." He recognizes that displacement of Late Archaic groups by others possessing completely different lithic tool forms and ceramics is hardly a feasible explanation. The

"Transitional Archaic" that bridges that gap and is recognized elsewhere, he feels, "will be found when further explorations are complete in this area (ibid.)."

The idea of a Transitional Late Archaic/Early Woodland horizon is not new, of course, especially for areas outside the North Carolina Piedmont (Witthoft 1971; Turnbaugh 1975). Exact definition and recognition in clear stratigraphic contexts in the Piedmont, however, are lacking despite recent assertions that it should exist (Woodall 1976:129; Claggett et al, 1978:81).

Excavations of Site Ch29 have demonstrated the presence of a Late Archaic occupation immediately below developmental horizons (cf. Wilson 1976:20, 59). No attempt has been made by other researchers to integrate the two components, but finer excavation controls may reveal correlations or distinctions between the lithic, if not the ceramic artifacts from the two occupations. Keel (1976:196) has discussed continued use of the Otarre point during the ceramic period in western North Carolina, while recognizing that type as a "lineal descendant" of the Savannah River Stemmed point type. Our surface collections produced a single Otarre-like point from the southeastern terrace system, so we may be able to recognize at least a blurring of the distinctions between Late Archaic and Early Developmental assemblages. Excavations elsewhere in the southeast have revealed a similar situation (Faulkner and Graham 1966:122-125; Chapman 1973:130), so maintaining a position of clear distinctions may not be valid if Savannah River/Otarre lithics actually cooccur with Early Developmental (Badin?) ceramics.

Middle and Early Archaic Tool Forms

One of the most elusive problems in North American archeology is the functional interpretation of lithic tool forms, especially hafted bifaces commonly known as projectile points. Recovery and analysis of specimens from the stratified Haw River sites may allow us to shed light on this problem, particularly during the Middle and Early Archaic periods (ca. 8000-2500 BC). As culture-chronology indices, these items have demonstrated utility, usually as named types (cf. Coe 1964; Cambron and Holse 1969; Broyles 1971; Chapman 1975, 1978; Bell 1958, 1960).

Morphological changes in blade shape and hafting elements have traditionally been the focus of investigators. Recently, however, attentions have logically shifted to definition of the functional and processual aspects of why and when those "stylistic" changes occurred. Notable studies

along these lines include Ahler (1971) and Luchterhand (1970) who have assessed the covariance of certain metrical attributes of hafted bifaces and, combined with replicative experimentation, have posited functional interpretations for those items. More recently, Goodyear (1974), Chapman (1975, 1977), Broyles (1971), Poplin (1978), and others have built on such studies in attempts to equate stylistic/functional variations with cultural and environmental changes. Since point types are commonly used as cultural/temporal period definiens they should demonstrate some validity for that role other than intuitively defined categories of what points "look alike."

Excavation and detailed attribute analysis of hafted bifaces from Sites Ch29 and 8 are expected to build on the basic chronological frameworks of Coe (1964) and others. Additionally we hope to better document the functional aspects of Archaic biface forms, particularly in terms of hafting elements. Guided by the work of Ahler, Luchterhand and others, we will examine the questions of why certain artifact attributes of blade shape, edge angle and hafting elements covary among the recognized types identified as Palmer, Kirk, Stanly, Morrow Mountain and Guilford. On a basic level, obvious stylistic changes in hafting elements (stemming, notching, socketing, etc.) may reflect technological adaptations to changing environmental conditions. These investigations will elucidate both chronological, stylistic problems common to other Piedmont sites and more processually oriented questions of changing subsistence strategies during the Early and Middle Holocene.

Early Archaic Settlement/Subsistence

Perhaps the most exciting element of the proposed Haw River data recovery program centers on the demonstrated existence of deeply stratified, in situ Early Archaic cultural materials. Commonwealth's proposed excavation strategy is designed to recover the maximum amount of data on this poorly-understood cultural stage (cf. Tuck 1974).

Following the leads of several recent studies in southeastern archeology (Broyles 1971; Chapman 1975, 1977, 1978; Goodyear 1974) we will attempt to define living floors and spatially segregated tool clusters dating to this period. Test excavations by Commonwealth crews in May and June of 1979 and UNC-Chapel Hill crews several years earlier (McCormick 1970; Wilson 1976) have proven the existence of stratified Early Archaic site components at Ch8 and Ch29, highly productive of lithic tools and debris. Major block excavations are proposed to reveal areally-extensive levels of the sites which combined with piece-plotting of artifacts (Goodyear 1974; Gardner 1974; Chapman 1975, 1978) will provide invaluable data on Early Archaic behavioral patterns.

Definition of living floors and tool clusters will be accomplished through accurate recording (piece-plotting) and elevational controls and by using computer generated statistical tests of association and three-dimensional graphic displays. By analyzing the spatial dimensions of tool and debitage clusters, we can isolate activity areas as well as task-specific functional tool assemblages and tool classes.

Problems do, of course, exist when attempting such reconstructions, even on clearly stratified sites (cf. Chapman 1975:199). We hope to minimize difficulties identified by other investigators by excavating natural, rather than arbitrary, levels and by close on-going coordination of archeological and geomorphological data.

The specific computer and statistical techniques used will depend, of course, on the quality and quantity of data recovered. We anticipate finding sufficient cultural materials to perform at least the basic associational tests discussed by Ammerman and Feldman (1974); Dacey (1973) and Whallen (1973, 1974).

<u>Paleo-Indian Occupations</u>

Late Pleistocene or Early Holocene occupations in eastern North America are well-documented, but mainly on the basis of surface-collected artifacts. Excavated sites do exist, but Paleo-Indian cultural manifestations remain elusive, especially as they relate to the later cultural stages termed Archaic (Griffin 1967; Williams and Stoltman 1965; Dragoo 1976; Adovasio et al, 1977).

Sites 31Ch8 and Ch29 have demonstrated capacity for revealing <u>in situ</u> cultural materials dating to the early Archaic stage (Wilson 1976; this report). Test excavations have also hinted at earlier occupations, based on recovery of a Hardaway point (unfortunately out of context) (Wilson 1976) and other artifacts presumably associated with a very early Archaic or late Paleo-Indian occupation zone (this report). Excavation of other deeply-stratified archeological sites in the eastern United States have produced only similarly tentative data indicative of an Archaic/Paleo-Indian interface (Gardner 1974, 1977; Adovasio et al, 1977; Chapman 1975, 1978; Broyles 1971; Coe 1964).

The basic excavation strategy outlined in this proposal may produce data on at least Hardaway age utilization of the 31Ch8 and Ch29 site area. If encountered, we expect to be able to apply at least some of the analytic procedures detailed for Kirk horizons to those data. Recovered artifacts, especially hafted bifaces, will be subjected to quantitative metric attribute analysis in order to demonstrate continuities or disparities in artifact form or lithic technology traditions. Hopefully, basal cultural strata will also prove amenable to delineation and interpretation of living floors and activity areas as described in preceding paragraphs.

APPENDIX A

CONTRACTOR'S MITIGATION PROPOSAL (RESULTING FROM THE PHASE I INVESTIGATIONS OF CONTRACT DACW54-79-C-0020)

ATTACHMENT TO SCOPE OF WORK

FOR

ARCHAEOLOGICAL EXCAVATION OF SITES CH8 AND CH29, B. EVERETT JORDAN DAM AND LAKE, NC

SCOPE OF WORK FOR ARCHAEOLOGICAL EXCAVATION OF IMPOUNDMENT ZONE SITES B. EVERETT JORDAN DAM AND LAKE, NC

1. Statement of Work. The work to be accomplished under this contract consists of the execution of mitigation activities defined on the basis of previously conducted archaeological and geological survey and testing. The results of this most recent research are contained in the Report of Phase I Investigations and a Proposed Mitigation Program for Sites 31Ch8, 31Ch28 and 31Ch29, B. Everett Jordan Dam and Lake, Chatham County, North Carolina, prepared by Commonwealth Associates Inc., under Contract DACW54-79-C-0020. The work described herein was originally planned as Phase II of the aforementioned research but is now to be conducted under this separate contract. The Contractor's mitigation proposal for accomplishing the work required by this contract shall be attached to and made a part of this Scope of Work as Appendix A. The sites to be investigated are believed to contain in situ horizons from at least the Early, Archaic through Woodland periods. These horizons are sealed in overbank deposits occuring on a remnant terrace system. These terraces are located in a fault basin on the otherwise well dissected lower reaches of the Haw River near its confluence with the New Hope River.

2. Corps of Engineers Project Description. The B. Everett Jordan Lake will impound the waters of the Haw River and its principal tributary, the New Hope River. The drainage area above the dam is 1,690 square miles. At the top of the conservation pool, 216 feet above mean sea level (above msl), the lake will have a surface area of 14,300 acres. At the top of the flood control pool (240 feet above msl), the lake will have a surface area of 32,000 acres. At elevation 216 feet above msl (conservation pool), the lake will have a shoreline of 150 miles, the impoundment extending for 5 miles on the Haw River and 17 miles on the New Hope River. The conservation pool will lie entirely within Chatham County, although the approximately 47,000 acres of land to be acquired in connection with the project will extend into Durham, Orange, and Wake Counties.

3. Items to be furnished by the Contracting Officer.

a. A supply of NTIS-35 forms with instructions for completing form

b. Project maps at 1:12000 scale

c. Copies of reports or relevant sections of reports listed under the following Paragraph 4a.

4. Description of Services to be Performed.

a. Literature and Background Search. The Contractor will become thoroughly familiar with previous research conducted at the Jordan project, as listed in the bibliography below. In addition, the Contractor's proposal will demonstrate a detailed knowledge of southeastern archaeology and the prehistory of the N.C. Piedmont. Selected bibliography is as follows:

(1) An Archaeological Survey of the New Hope Valley. Gerald P. Smith. Unpub. thesis, Chapel Hill, University of North Carolina, 1965.

(2) A Further Appraisal of the Archaeological Resources of the New Hope Reservoir, N.C. Olin F. McCormick III (Field Director) and Joffre L. Coe, principal investigator (P.I.). Chapel Hill: Research Labs of Anthropology/National Park Service. 1969. Contract No. 14-10-1-910-19.

(3) Archaeological Resources of the New Hope Reservoir Area, North Carolina. Olin F. McCormick III. Unpub. thesis, Chapel Hill, University of North Carolina, 1970.

(4) Final Report: 1974. Excavations Within the New Hope Reservoir. Jack H. Wilson, Jr. (Field Director) and Joffre L. Coe (P.I.). Chapel Hill: Research Labs of Anthropology/National Park Service. Contract No. CX5000-3-1663.

(5) An Archaeological Assessment of the Relocation of State Road 1008 and 1715 in the B. Everett Jordan Reservoir, North Carolina. William O. Autry, Jr., 1976. Unpub. nss., Corps of Engineers, Wilmington District.

(6) Draft Report: An Archaeological and Historic Site Survey of Chatham County. Judith A. Newkirk, Jackson, Michigan: Commonwealth Associates Inc., 1978. Prepared under COE Contract No. DACW54-78-M-1645.

(7) Report of Phase I Investigations and a Proposed Mitigation Program for Sites 31Ch8, 31Ch28, and 31Ch29, B. Everett Jordan Dam and Lake, Chatham County, North Carolina. Commonwealth Associates Inc. Prepared under COE Contract No. DACW54-79-C-0020.

b. Proposals. Proposals must contain evidence of a rational stepwise approach to research. All proposed excavation and analytic methods and their scheduling will be thoroughly explicated in the proposal. The proposal must demonstrate an integrated framework of recovery and analysis. It should be clear from the proposal how the analysis will aid interpretation and address relevant archaeological problems. Following Goodyear, Raab and Klinger (The Status of Archaeological Research Design and Cultural Resource Management. American Antiquity 43:159-173, 1978) the research design shall be "...an explicit plan for solving a problem or set of problems. It is a plan that must contain ...goals in the form of a specific problem or hypothesis, relevant analytical variables, and specification of data that will allow empirical testing... The design must lay out the methods and techniques for acquiring and analyzing the data, and predict the expected outcomes of analysis (p. 161)." Goals subsumed under "salvage archaeology" are, therefore, necessary but not sufficient conditions for acceptance of the research proposal. Proposals may seek to integrate data in a number of ways. For instance, Early Archaic occupations occur on the two sites described in this Scope of Work. These sites may be taken together in design, analysis, and reporting; or data from these sites may be combined with data gathered from other localities or regions. The analysis may address chronology, stylistic variation, ecology, culture change or any other relevant issues. In any case, preference will be given to analytical strategies that promise to go beyond cultural classification.

c. Excavation. The area to be investigated includes Sites Ch^{v}8 and Ch^{v}29 which were originally investigated by McCormick (1970) and Wilson (1976) under the supervision of Dr. Joffre L. Coe. Both of these sites have been determined eligible for inclusion on the National Register of Historic Places.

(1) Testing at Ch^{v}8 demonstrates the presence of stratified soil deposits containing Early Archaic and earlier horizons. Evidence for later occupations has apparently been destroyed since these deposits occur at a shallower depth below surface than at Ch^{v}29. Indications of pre-Kirk occupation are found at 1.1 to 1.75 meters below the surface. Surface area of the site is approximately 16,500 square meters.

(2) Ch^{v}29 is just south of Ch^{v}8. At this site artifacts have been recovered at depths exceeding 1.8 meters but averaging 1.5 meters at the Kirk level. The site has produced a very small amount of Badin Series ceramics. Uwharrie and New Hope Series comprise the bulk of the ceramic collection, with the historic Hillsborough Series being a minority type exceeding only the Badin Series in quantity.

Preceramic occupations are represented by Savannah River, Kirk, and Hardaway projectile points. Thirty-two features have been excavated at the southern end of this site; all are thought to be Woodland period. Previous excavations have exposed a minimum of 180 square meters to Level 3, the level where features are first encountered. A total of nine test pits have also been dug to various depths. Joffre Coe feels that the historic component has been sufficiently excavated and recommends placing emphasis on earlier components. This may entail the excavation of units previously excavated to Level 3 (base of plow zone; first occupational level) and/or work in other areas of the site. $Ch^{V}29$ is approximately 9,375 square meters in area.

(3) The excavations to be conducted under this Scope of Work shall adhere to recommendations and results of previous researchers except where a variance from such recommendations can be shown to increase the potential information resulting from analysis. Since the primary significance of these sites is in pre-Woodland occupations, the bulk of the field effort should be directed at these assemblages. The stratified nature of the deposits and the possibility of encountering in situ features makes chronological and behavioral goals paramount. All excavations shall be thoroughly documented in the field through the use of level and feature drawings and photos, excavation unit notes and daily records. Both field and laboratory procedures will be monitored by COE staff archaeologists or consultants and perceived deficiencies in recording will be corrected by the principal investigator.

d. <u>In-Progress Recommendations</u>. In order to allow for the wisest use of time and insure adequate coverage, the Contractor shall make and justify suggestions for further research as soon as evidence accumulates suggesting that further work is needed.

e. <u>Site Security</u>. Over the past years, amateur collectors have damaged these and other archaeological and historic sites in the B. Everett Jordan project area. The Contractor will be responsible for securing the sites outlined herein against vandalism during the period of service of this contract. This will require daily patrolling of the sites during off-work hours.

f. <u>Documentation</u>.

(1) <u>Monthly Progress Reports</u>

(a) The Contractor will be required to submit detailed monthly progress reports. These reports shall contain an accurate, up-to-date account of all laboratory and

fieldwork procedures and results and will specify the percent of completion of contracted research. The report must be forwarded to the Contracting Officer's Representative (COR) not later than the fifth day of each month.

(b) Project directors (principal investigators) are required by this Scope of Work to perform periodic field inspection and direction. On-site visitation should be made as a matter of routine and shall be detailed in the appropriate monthly report.

(2) Site Forms. All sites will be recorded on current, computer adaptable N.C. site forms (Contractor provided). Instructions published by the N.C. Division of Archives and History will be followed in filling out N.C. site forms.

(3) Form NTIS-35. Copies of the final report will be maintained on microfiche by the National Technical Information Service (NTIS) and will be available from NTIS to interested persons. Each report is to include Form NTIS-35 (provided by the Corps of Engineers) as its first page. Blocks 4, 5, 7, 9, 11, 12, 13, 15, 16, and 21 of Form NTIS-35 will be completed by the Contractor.

g. Report Requirements.

(1) Report Format and Content. Final drafts of reports of investigations shall reflect and report the analysis outlined in this Scope of Work. They shall meet current professional needs and be suitable for publication and be prepared in a format reflecting contemporary organizational and illustrative standards of the current professional archaeological, architectural, and historical journals. The report will be prepared on 8-1/2 x 11-inch paper and typed, single-spaced. All pages must be numbered. Photographs, plans, maps, drawings and text must be clean and clear. Final reports will be bound in Perfect binding. In addition, all reports must contain the following:

(a) High quality photographs shall be provided which show details of features, profiles, artifacts, or other evidence of human occupation.

(b) If a report has been authored by someone other than the contract principal investigator, the cover and title page of the publishable report must bear the inscription Prepared Under the Supervision of (Name), Principal Investigator. The principal investigator is required to sign the original copy of the report.

(c) If a report has been authored by someone other than the contract principal investigator, the principal investigator must at least prepare a foreword describing the overall research context of the report, the significance of the work, and any other background circumstances relating to the manner in which the work was undertaken.

(d) The title page of the report must bear an appropriate inscription indicating the source of funds used to conduct the reported work.

(e) If the Contractor expects to publish all or part of the final report, he must provide the COR with a letter specifying the expected date, place, and name of publication. This letter must be submitted with the final report.

(f) Specific locations of sites found or otherwise identified as the result of investigations under this contract that might be subject to vandalism are to be submitted by the Contractor as a separate document, simultaneously with the final report.

(g) An abstract suitable for publication in an abstract journal must be prepared. This should consist of a brief, quotable summary useful for informing the technically oriented professional public of what the author considers to be the contributions of the investigation.

(h) A brief, nontechnical summary of the survey and excavation results and their significance to the study of human prehistory (and history) will be prepared and submitted separately from the final report. The narrative should be oriented toward the nonprofessional public. The purpose of this document is to inform the interested public of the kinds of activities and research conducted by anthropologists using public funds. The nontechnical report should give a complete synopsis of the project and should be in a style and length adaptable to a newspaper article or short information bulletin. Photographs and/or drawings of significant artifacts and sites should be included.

(2) All final reports may be submitted by the Corps of Engineers to the N.C. Division of Archives and History for publication in the <u>N.C. Archaeological Council Publications in Archaeology</u> series.

5. <u>Drawings</u>. The drawings shall conform to the following criteria:

a. All drafting shall be accomplished in ink on 28" x 40" size stable-base drafting film. Drafting ink shall be compatible with stable-base film.

b. Either mechanical or freehand lettering may be used but shall be in accordance with good drafting practice. In no case shall lettering height be less than 1/8-inch.

c. Pencil shading on finished drawings will not be accepted. Shading will be accomplished with hatching or pre-printed "stick-on" screens. Lettering shall not be obscured with hatching or screening. Hatching on the reverse side of the drawing is preferred.

d. Finished drawings shall be prepared to produce clear and sharp images on 35 millimeter microfilm in order to avoid filled in loops or leaching of lines and/or characters on blowbacks.

6. Personnel/Agency Standards. Agencies, institutions, corporations, associations or individuals will be considered qualified when they meet the minimum criteria given below. As part of the supplemental documentation, a contract proposal must include vitae for the P. I. and main supervisory personnel in support of their academic and experiential qualifications for the research. In the event that support personnel have not been identified at the time of contract proposal, vitae on supervisory positions may be omitted until such time as they are identified, with the provision that those to be selected meet the minimum professional standards stated below and that their retention is subject to approval by the COR.

a. Archaeological Project Directors or Principal Investigators (P.I.). Persons in charge of an archaeological project or research investigation contract, in addition to meeting the appropriate standards for archaeologists, must have the doctorate or an equivalent level of professional experience as evidenced by a publication record that demonstrates experience in field project formulation, execution, and technical monograph reporting. Suitable professional references may also be made available to obtain estimates regarding the adequacy of prior work. If prior projects were of a sort not ordinarily resulting in a publishable report, a narrative should be included detailing the proposed project director's previous experience, along with references suitable to obtain opinions regarding the adequacy of this earlier work.

b. Archaeologist. The minimum professional qualifications in archaeology are:

(1) A graduate degree in archaeology, anthropology, or closely related field, or equivalent training accepted for accreditation purposes by the Society of Professional Archaeologists;

(2) Demonstrated ability to carry research to completion, usually evidenced by timely completion of theses, research reports, or similar documents; and

(3) At least 16 months of professional experience and/or specialized training in archaeological field, laboratory, or library research, administration, or management, including at least four months experience in archaeological field research and at least one year of experience and/or specialized training in the kind of activity the individual proposes to practice. For example, persons supervising field archaeology should have at least one year or its equivalent in field experience and/or specialized field training, including at least six months in a supervisory role. Persons engaged to do archival or documentary research should have had at least one year experience and/or specialized training in such work. Archaeologists engaged in regional or agency planning or compliance with historic preservation procedures should have had at least one year of experience in work directly pertinent to planning, compliance actions, etc., and/or specialized historic preservation or cultural resource management training. A practitioner of prehistoric archaeology should have had at least one year of experience of specialized training in research concerning archaeological resources of the prehistoric period. A practitioner of historic archaeology should have had at least one year of experience in research concerning archaeological resources of the historic period. Experience in archaeological research in the region where the project will be undertaken is usually desirable.

c. Historian. The minimum professional qualifications in history are a graduate degree in American history or a closely related field, or a bachelor's degree in history or a closely related field plus one of the following:

(1) At least two years of full-time experience in research, writing, teaching, interpretation, or other demonstrable professional activity with an academic institution, historical organization or agency, museum, or other professional institution; or

(2) Substantial contribution through research and publication to the body of scholarly knowledge in the field of history.

d. Consultants. Personnel hired or subcontracted for their special knowledge and expertise must carry academic and experiential qualifications in their own fields of competence. Such qualifications are to be documented by means of vitae

attachments submitted with the proposal or at a later time if the consultant has not been retained at the time of proposal.

e. Institutional or Corporate Qualifications. Any institution, organization, etc., obtaining this contract, and sponsoring the principal investigator or project director meeting the previously given requirements, must also provide, or demonstrate access to the following capabilities:

(1) Adequate field and laboratory equipment necessary to conduct whatever operations are defined in this Scope of Work; however, this qualification may be waived under circumstances of extreme need through negotiations.

(2) Adequate facilities necessary for proper treatment, analysis, and storage of specimens and records likely to be obtained from a given project. This does not necessarily include such specialized facilities as pollen, geochemical, or radiological laboratories, but does include facilities sufficient to properly preserve or stabilize specimens for any subsequent specialized analysis.

7. Disposition of Data. When the recovered data have been removed from non-Federally owned lands, such as state, municipal, corporate, or privately held land, then negotiated arrangements must be made. The principle governing these negotiations is to be that, where public funds are expended for the recovery of such data, the public must be the benefactor. All data removed from Federally owned lands are the property of the Federal Government.

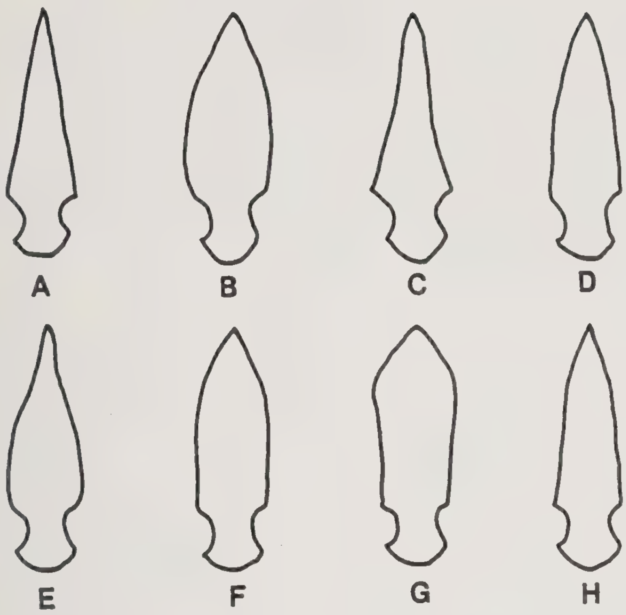
8. Release of Information. Neither the Contractor nor his representatives shall release any sketch, photograph, report or other material of any nature obtained or prepared under the contract without specific written approval of the COR prior to the time of final acceptance by the Government.

9. Period of Services. The Contractor shall commence work under this contract immediately upon official confirmation from the Contracting Officer to proceed. The Contractor shall complete all field work by 16 November 1979. The draft report shall be submitted by 1 March 1981. Review comments on the draft report will be returned to the Contractor by 1 May 1981. The Contractor shall submit the final report in 50 copies and have completed all contract work by 1 August 1981. The above is based on the Contractor being given a Notice of Contract Award by 8 August 1979.

10. Method of Payment. Partial payments to the Contractor for services performed under this contract will be made at the end of each month, based on an approved estimate of value of work accomplished during the month. The dollar value of each feature of work shall be indicated on a progress schedule. The amounts of partial payments due the Contractor shall be determined by the COR on the basis of approved progress reports expressed as percent of feature of work accomplished. Ten percent (10%) will be deducted from each partial payment estimate, such deductions to be retained until all work under the contract has been completed and accepted, at which time all remaining amounts due, together with retainage, will be paid to the Contractor.

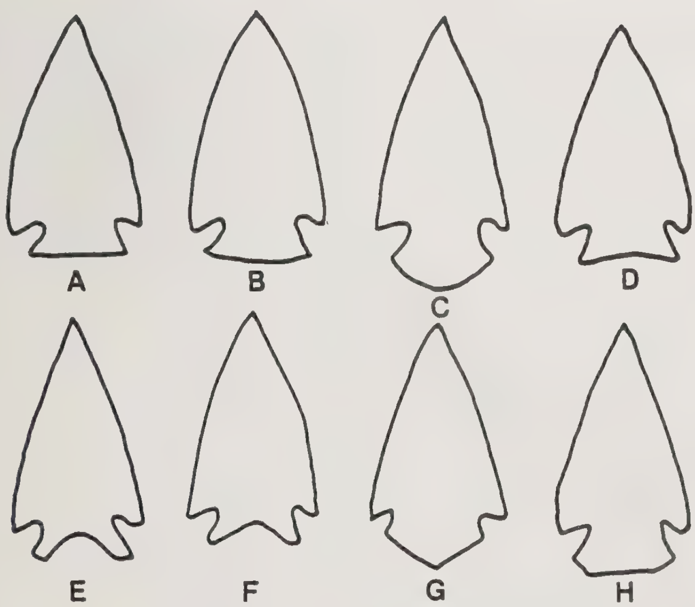
APPENDIX 2

LITHIC CODING VARIABLES



A. TRIANGULAR
B. EXCURVATE
C. INCURVATE
D. OVATE
E. EXCURVATE-INCURVATE
F. PARALLEL-OVATE
G. EXPANDING-OVATE
H. CONTRACTING-OVATE

BLADE SHAPES

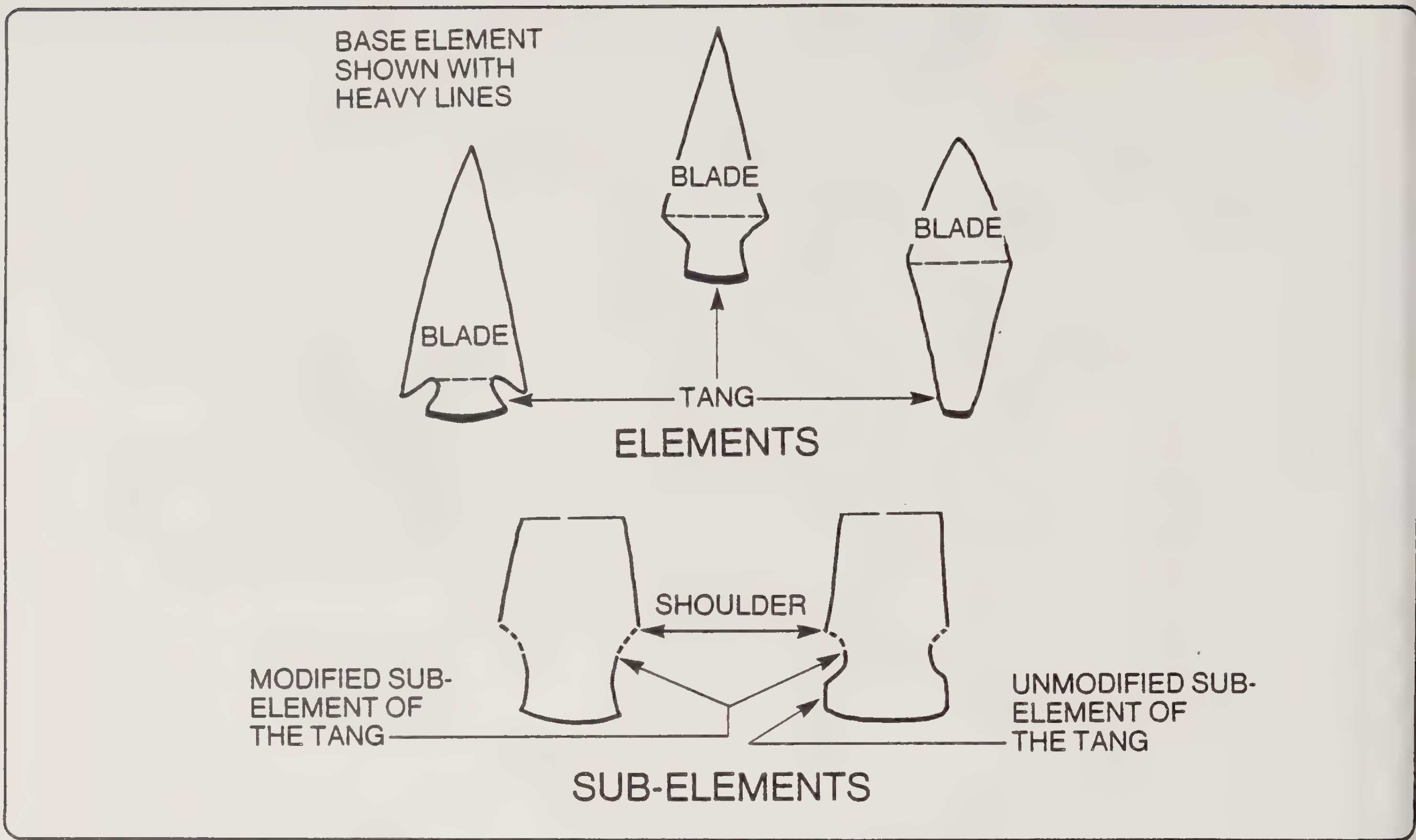


A. STRAIGHT BASE
B. SUBCONVEX BASE
C. CONVEX BASE
D. SUBCONCAVE BASE
E. CONCAVE BASE
F. TRIANGULO-CONCAVE BASE
G. BIVECTORAL BASE
H. TRIVECTORAL BASE

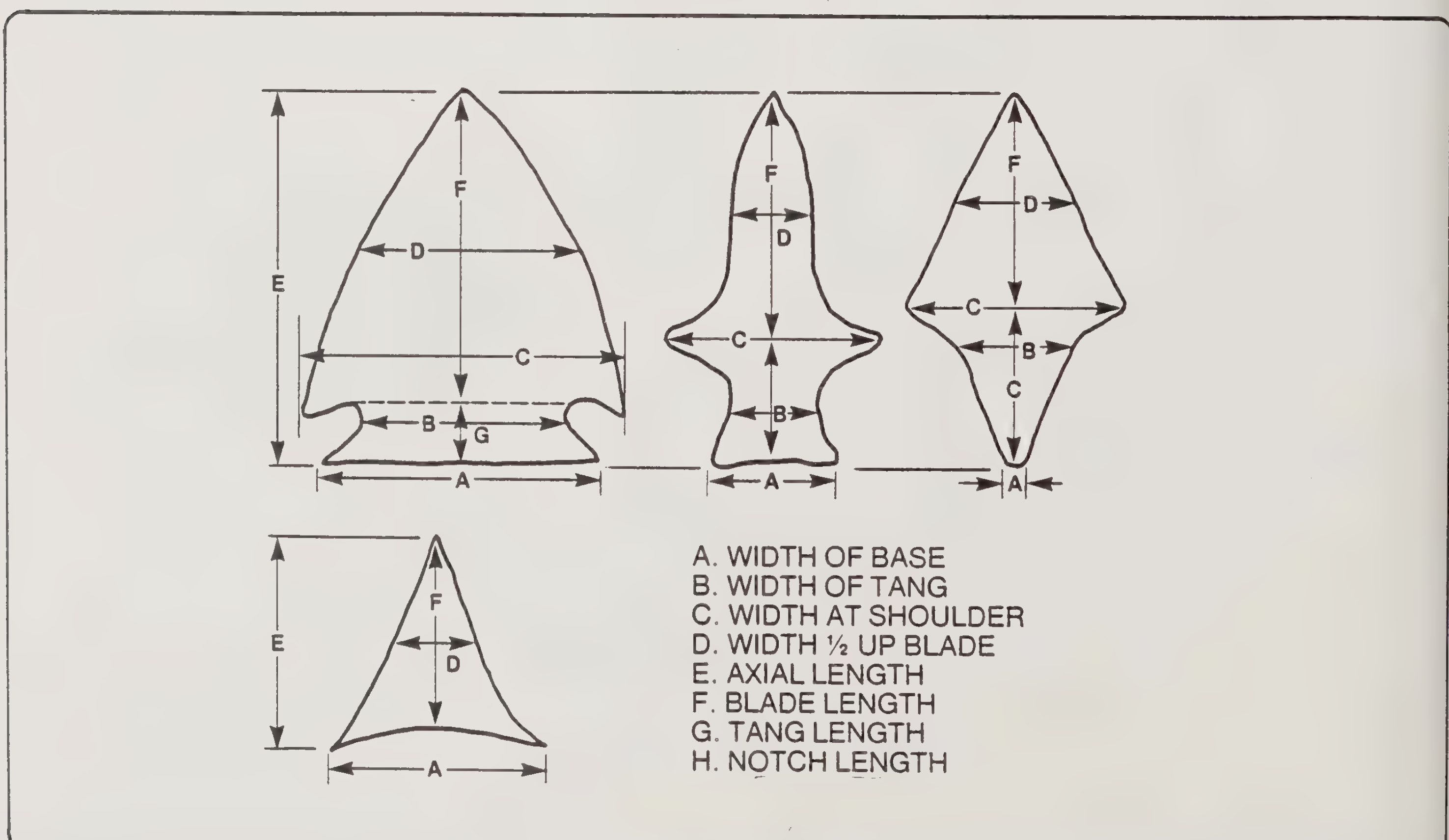
BASE SHAPES

DATA RECOVERY AT SITES 31CH29 & 31CH8
B. EVERETT JORDAN DAM & LAKE
CHATHAM COUNTY, NORTH CAROLINA
COMMONWEALTH ASSOCIATES, INC.

DESCRIPTION OF
BASE AND BLADE SHAPES
FOR PROJECTILE POINTS
(FROM BINFORD 1963)

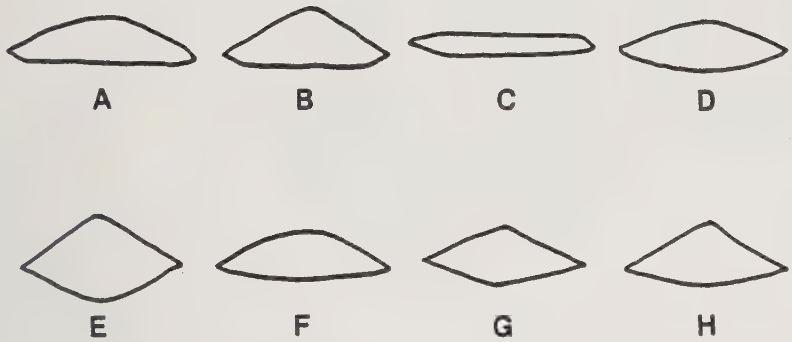


DESCRIPTION OF PROJECTILE POINT
ELEMENTS AND SUBELEMENTS (FROM BINFORD 1963)



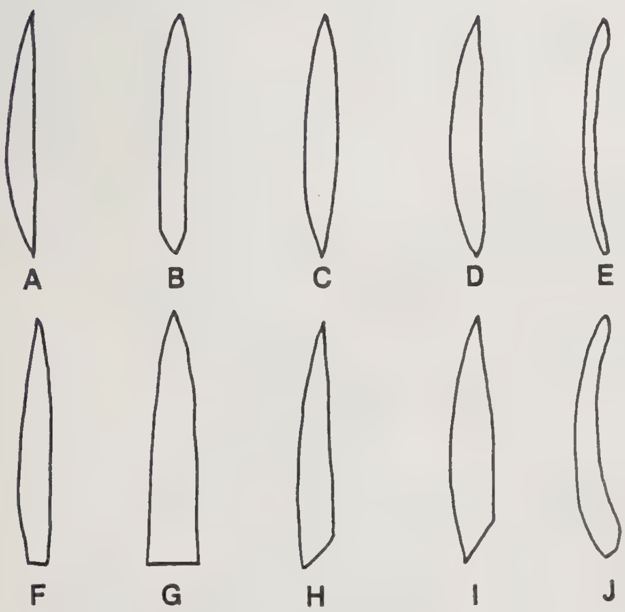
DATA RECOVERY AT SITES 31CH29 & 31CH8
B. EVERETT JORDAN DAM & LAKE
CHATHAM COUNTY, NORTH CAROLINA
COMMONWEALTH ASSOCIATES, INC.

METRIC DIMENSIONAL MEASUREMENTS
FOR PROJECTILE POINTS



A. PLANO-CONVEX
B. PLANO-TRIANGULAR
C. BIPLANO
D. BICONVEX
E. BITRIANGULAR
F. ASYMMETRICALLY BICONVEX
G. ASYMMETRICALLY BITRIANGULAR
H. CONVEXO-TRIANGULAR

TRANSVERSE SECTIONS

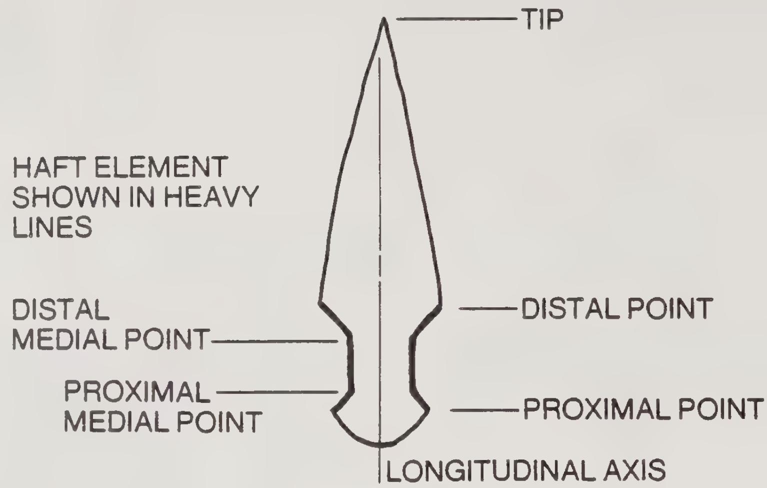


A. PLANO-CONVEX
B. BIPLANO
C. BICONVEX
D. ASYMMETRICALLY BICONVEX
E. CONCAVO-CONVEX
F. EXCURVATE
G. OVATE OF TRIANGULAR
H. ASYMMETRICALLY OVATE
I. ASYMMETRICALLY EXCURVATE
J. ASYMMETRICALLY CONCAVO-CONVEX

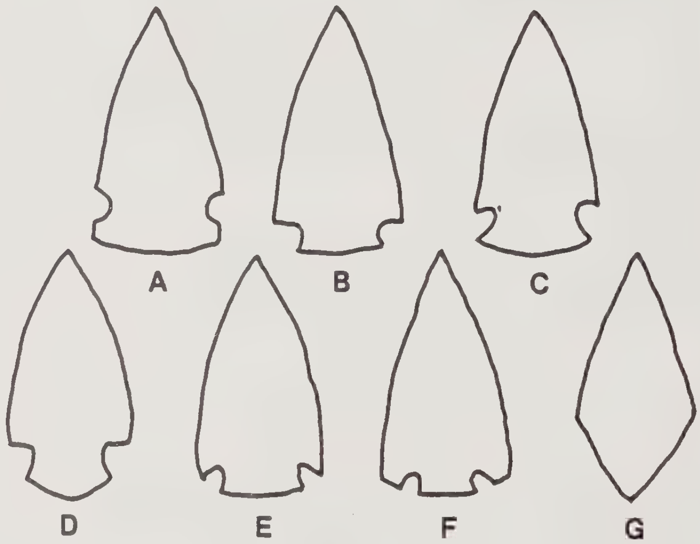
LONGITUDINAL SECTIONS

DATA RECOVERY AT SITES 31CH29 & 31CH8
B. EVERETT JORDAN DAM & LAKE
CHATHAM COUNTY, NORTH CAROLINA
COMMONWEALTH ASSOCIATES, INC.

DESCRIPTION OF
PROJECTILE POINT SECTIONS
(FROM BINFORD 1963)

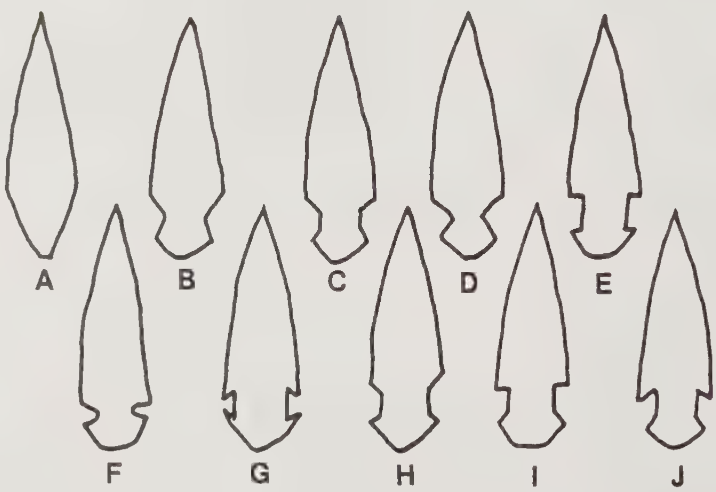


POINTS OF JUNCTURE



A. LATERAL - LATERAL JUNCTURE
B. LATERAL - BASAL JUNCTURE
C. LATERAL - COINCIDENTAL JUNCTURE
D. LATERAL - BASE DEFINING JUNCTURE
E. COINCIDENTAL - BASAL JUNCTURE
F. BASAL - BASAL JUNCTURE
G. LATERAL - AXIAL JUNCTURE

JUNCTURE



A. ABSENT
B. OBTUSE
C. BIOTUSE
D. RIGHT-ANGLED
E. BIRIGHT-ANGLED
F. ACUTE
G. BIACUTE
H. OBTUSE-RIGHT-ANGLED
I. RIGHT-ANGLED-OBTUSE
J. MULTIJUNCTURE

MEDIAL POINTS

DATA RECOVERY AT SITES 31CH29 & 31CH8
B. EVERETT JORDAN DAM & LAKE
CHATHAM COUNTY, NORTH CAROLINA
COMMONWEALTH ASSOCIATES, INC.

DESCRIPTION OF
HAFT ELEMENT JUNCTURES
(FROM BINFORD 1963)

BIFACE ANALYSIS CODING FORM

NOTE: ADDITIONAL PIECES: Are there other pieces of a specific biface from other proveniences? All of these pieces should be analyzed as a whole. The various proveniences and fragment type (condition) should be recorded in sequence on the analysis form, although measurements need be only entered on one line as illustrated below:

	PROVENIENCE	ADD. PIECES	RECONSTRUCTED ANALYSIS
Line 1:	29, A, 16, 1, 117, 9	1	
Line 2:	29, A, 16, 2, 116, 3	2	No Analysis Entered
Line 3:	29, A, 15, 7, 114, 2	3	No Analysis Entered

Additional pieces recorded as number of additional pieces in sequential order. (ie., Piece No. 1, Piece No. 2, etc.)

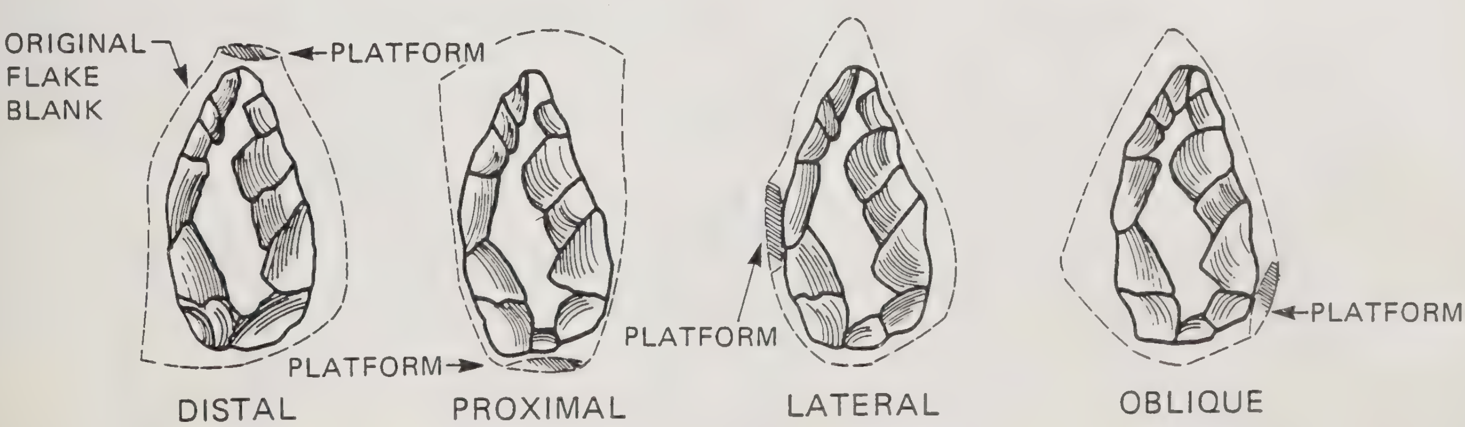
1. RAW MATERIAL TYPE:

2. CONDITION:

   1 — WHOLE
   2 — TIP
   3 — BASE
   4 — INDETERMINATE END (Either Tip or Base)
   5 — LATERAL SECTION
   6 — TIP MISSING
   7 — BASE MISSING
   8 — LATERAL SECTION MISSING

3. FLAKE BLANK ORIENTATION:

   1 — DISTAL ORIENTATION (Platform of original flake blank coincides with tip of biface)
   2 — PROXIMAL ORIENTATION (Platform of original flake blank coincides with base of biface)
   3 — LATERAL ORIENTATION (Platform of original flake blank coincides with one of lateral edges)
   4 — OBLIQUE ORIENTATION (Platform of original flake blank is positioned obliquely to longitudinal axis of biface)
   5 — OBSCURED (Biface wholly present, but thinning has obscured position of original flake platform)
   6 — INDETERMINATE OR ABSENT (Fragment exhibits no evidence of platform)

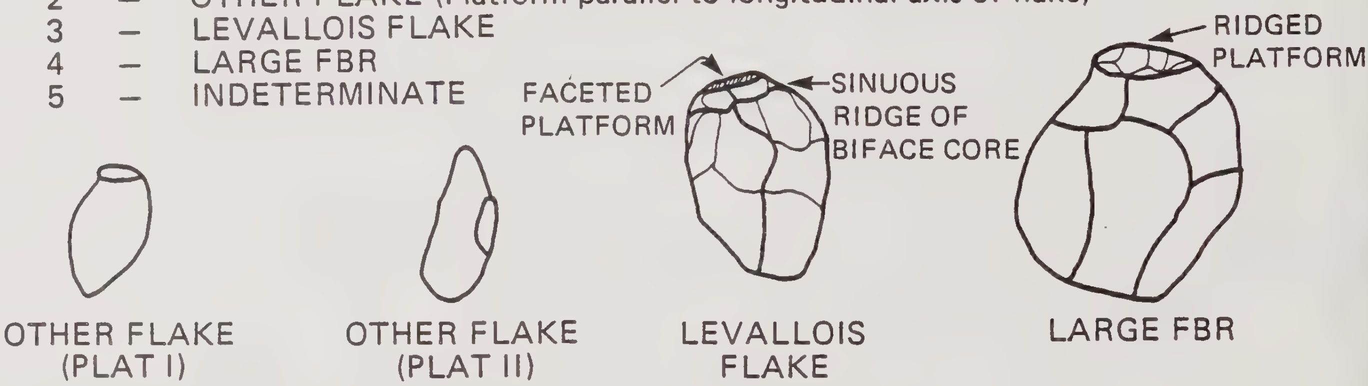


4. TYPE OF PLATFORM

1 — FLAT (Platform is composed wholly of cortex, flake scars are absent)
2 — RIDGED (Biface edge)
3 — UNI-FACETED (One flake scar)
4 — BI-FACETED (Two flake scars)
5 — MULTI-FACETED (More than two flake scars)
6 — INDETERMINATE OR ABSENT (Fragment does not exhibit platform)
7 — OBSCURED (Biface whole, but platform obscured by flaking)

5. TYPE OF BLANK

1 — OTHER FLAKE (Platform perpendicular to longitudinal axis of flake)
2 — OTHER FLAKE (Platform parallel to longitudinal axis of flake)
3 — LEVALLOIS FLAKE
4 — LARGE FBR
5 — INDETERMINATE

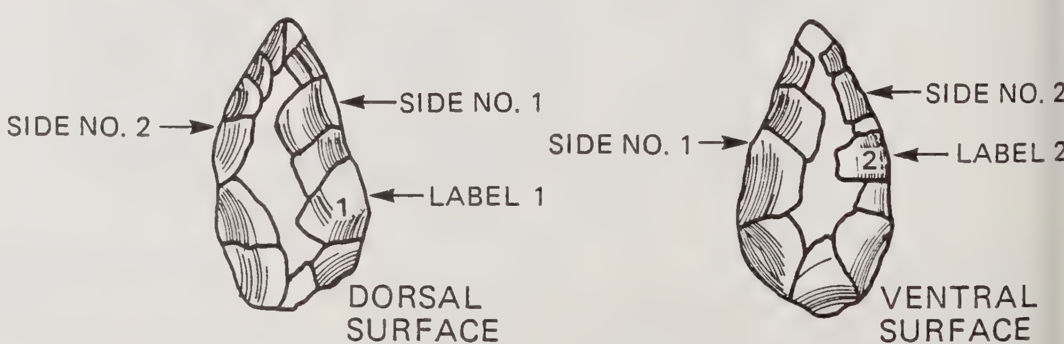


6 & 7. % CORTEX — FACES 1 & 2

1 — 0%
2 — 1 -25%
3 — 26-50%
4 — 51-75%
5 — 76-100%

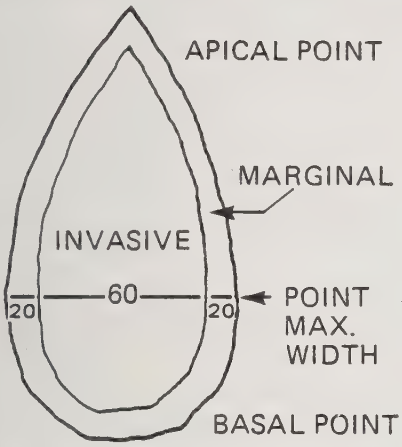
DEFINITIONS AND DIRECTIVES

FACE ORIENTATION — If a distinction can be made concerning the dorsal and ventral face of a biface blank, then the dorsal face should be referred to as Face No. 1 and the ventral face should be Face No. 2. If this is not possible (meaning that the initial flake characteristics have been obscured by bifacial flaking or that the biface in question was derived from a core or mass of material other than a flake blank), then refereence is arbitrary. However, each face should be labeled so that it can be cross-referenced or reconstructed in future analyses. This can be accomplished to coincide with labelling for the lateral sides of each biface as well, so that Face No. 1 will also refer to Lateral Side No. 1. This is illustrated below:



8-17.

BIFACIALITY – This category of information was developed to monitor the variability in retouch treatments across the biface assemblage. Two concepts are central to this category: 1) location and 2) type of flake scar. Location is determined by the definition of two zones: a marginal zone and an invasive (or internal) zone. The marginal zone encompasses approx. 40% of the face of a biface and the invasive zone is designed to encompass the rest. These zones are depicted graphically below:



The marginal zone is thus figured by 1) calculating the width at any point (usually do this with three points), 2) obtaining a value of 20% of this width, and then 3) measuring in from the lateral margins the distance obtained by the second step. Usually take these measurements at the point of maximum width and one point on either side; this will give a best approximate measure.

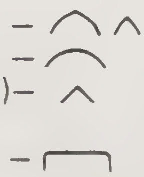
Flake scars can be divided into three types based on size:

1. **MASSIVE PRIMARY SCAR**: Both demensions exceed 10mm in distance.
2. **DIMINUTIVE PRIMARY SCARS:** Both dimensions of the scar exceed 5mm in distance, but at least one dimension does not exceed 10mm.
3. **MARGINAL RETOUCH:** At least one dimension of the scar does not exceed 5mm in distance.

Each scar type is monitored in terms of frequency of occurence within the Marginal and Invasive zones of each face. A scar counted in the marginal zone should not be recounted in the invasive zone even if it overlaps.

18. SHAPE OR LATERAL/LATERAL OR LATERAL/DISTAL INTERSECTION:

0 – MISSING
1 – OVATE (Curved expanding lat. edges intersecting in a point) –
2 – OVOID (Curved expanding lateral edges with rounded tip) –
3 – TRIANGULAR (Straight expanding lat. edges intersecting in a point) –
4 – SUBRECTANGULAR (Semi-parallel and straight lateral edges connected by a perpendicular distal edge) –

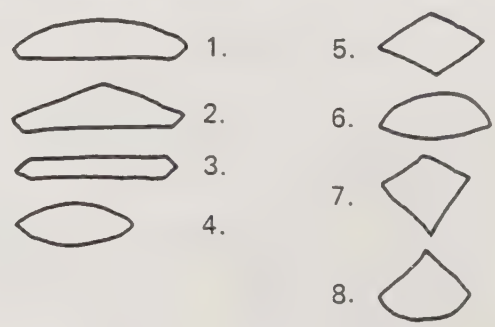


19. SHAPE OF LATERAL/PROXIMAL INTERSECTION

0 – MISSING
1 – OVATE
2 – OVOID
3 – TRIANGULAR
4 – SUBRECTANGULAR
5 – TRAPEZOID –
6 – SUBTRAPEZOID –

20. TRANSVERSE SECTION OF BLADE (Orient so that tip faces observer)

1 – PLANO-CONVEX
2 – PLANO-TRIANGULAR
3 – BIPLANO
4 – BICONVEX
5 – BITRIANGULAR
6 – ASYMMETRICALLY-BICONVEX
7 – ASYMMETRICALLY-BITRIANGULAR
8 – CONVEXO-TRIANGULAR
9 – IRREGULAR



21. LONGITUDINAL SECTION

1 – PLANO-CONVEX
2 – BIPLANO
3 – BICONVEX
4 – ASYMMETRICALLY BICONVEX
5 – CONCAVO-CONVEX
6 – EXCURVATE
7 – OVATE OR TRIANGULAR
8 – ASYMMETRICALLY-OVATE
9 – ASYMMETRICALLY-EXCURVATE
10 – ASYMMETRICALLY-CONCAVO-CONVEX

22-25. FORM OF LATERAL EDGE NO. 1, LATERAL EDGE NO. 2, DISTAL EDGE, PROXIMAL EDGE

1 – SERRATION
2 – EVEN (Chipped)
3 – EVEN (Ground)
4 – SINUOUS (Marginal Scars < 5mm)
5 – SINUOUS (Diminutive Primary Scars > 5mm < 10mm)
6 – SINUOUS (Massive Primary Scars > 10mm)
7 – POINT
8 – IRREGULAR

26. SYMMETRY OF BLADE

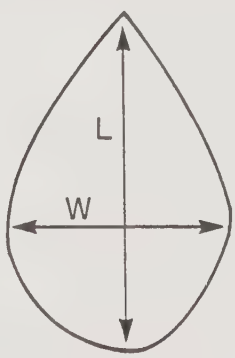
1 – SYMMETRICAL
2 – ASYMMETRICAL

METRIC ATTRIBUTES

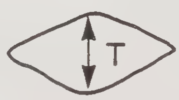
27. MAXIMUM WIDTH

28. MAXIMUM LENGTH

29. MAXIMUM THICKNESS



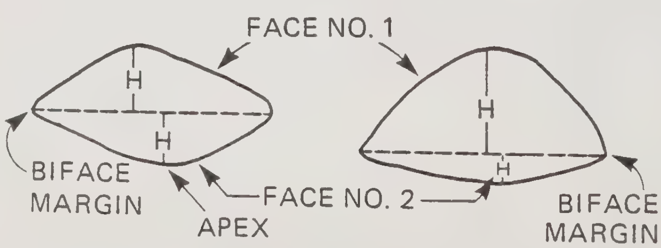
TOP VIEW



CROSS SECTION

30. HEIGHT OF FACE NO. 1

31. HEIGHT OF FACE NO. 2



32. WEIGHT (Grams)

33, 34,
35. AVERAGE EDGE ANGLES
(Record all three measurements for each edge on separate sheet)

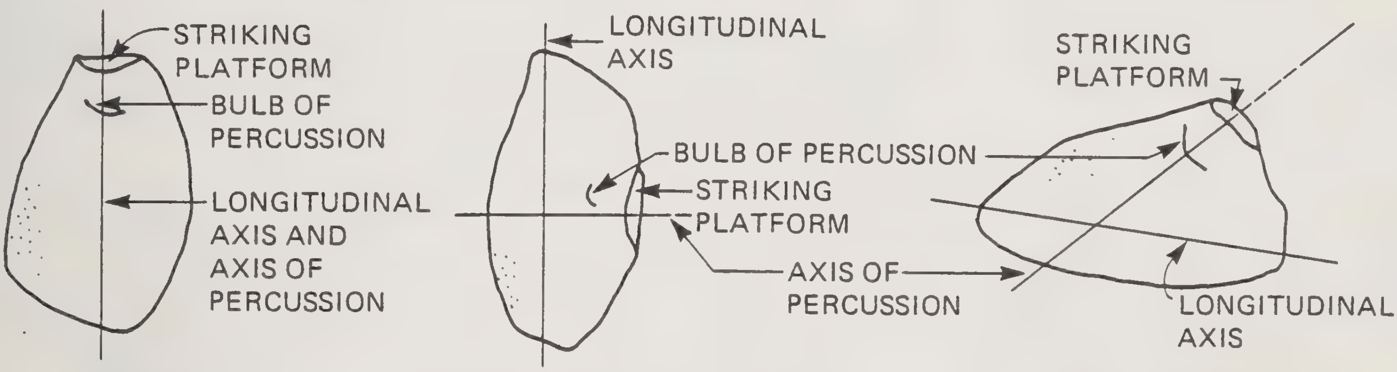
1/4, 1/2, 3/4 Up Blade

36. TIP ANGLE

UNIFACES AND OTHER FLAKE TOOLS (SITUATIONAL GEAR) CODING FORM

1. **RAW MATERIAL TYPE:** Those types determined intuitively from macroscopic observation.
2. **CONDITION:** WHOLE: 1; BROKEN (IRREGULAR): 2; HAFT ELEMENT MISSING: 3
3. **FLAKE TYPE:** FBR: 1; OTHER: 2; OBSCURED: 3
4. **% CORTEX:** NONE: 0; 1-25%: 1; 26-50%: 2; 51-75%: 3; 75-100%: 4
5. **PLACEMENT OF PRIMARY SCARS:** ABSENT: 0; DORSAL ONLY: 1; VENTRAL ONLY: 2; UNIFACIAL OBSCURED: 3
6. **PLATFORM ORIENTATION:** PARALLEL: 1; PERPENDICULAR: 2; OBLIQUE: 3; OBSCURED: 4

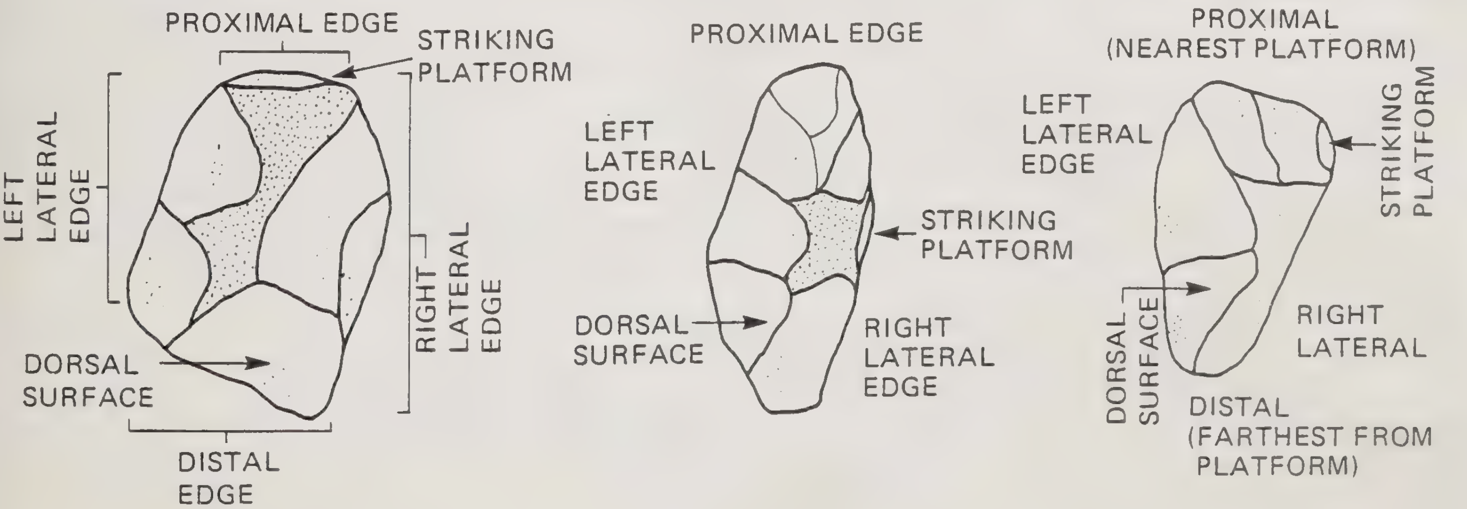
DEFINITIONS: PARALLEL = Platform oriented so that axis of percussion of flake and longitudinal axis are parallel
PERPENDICULAR = Platform oriented so that axis of percussion of flake intersects longitudinal axis at a roughly 90° angle
OBLIQUE = Platform oriented so that axis of percussion of flake intersects longitudinal axis at an oblique angle



7. **SIZE CLASS:** Following classes established for debitage analysis

DEFINITION OF EDGES: To maintain comparability of edges, the following procedure has been developed.

1. For Parallel Platform Orientation:
2. For Perpendicular Orientation: (PLATFORM PLACED TO RIGHT)
3. For Oblique Orientation: (PLATFORM PLACED TO RIGHT)

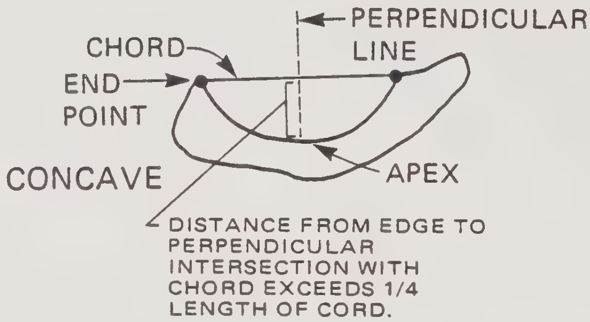


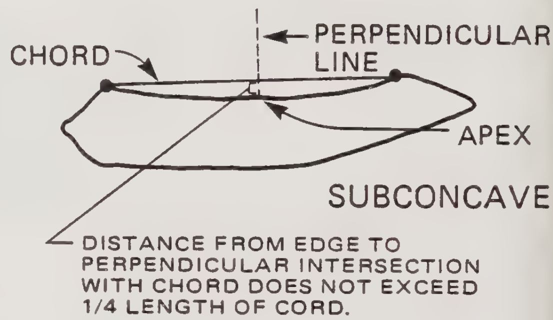
8. **EDGE OUTLINE:** For each edge that exhibits retouch or utilization. All other edges should be coded with a "0".

CONCAVE: 1	CONCAVO-CONVEX: 6
SUBCONCAVE: 2	PROJECTION: 7
STRAIGHT: 3	DENTICULATED: 8
CONVEX: 4	IRREGULAR: 9
SUBCONVEX: 5	

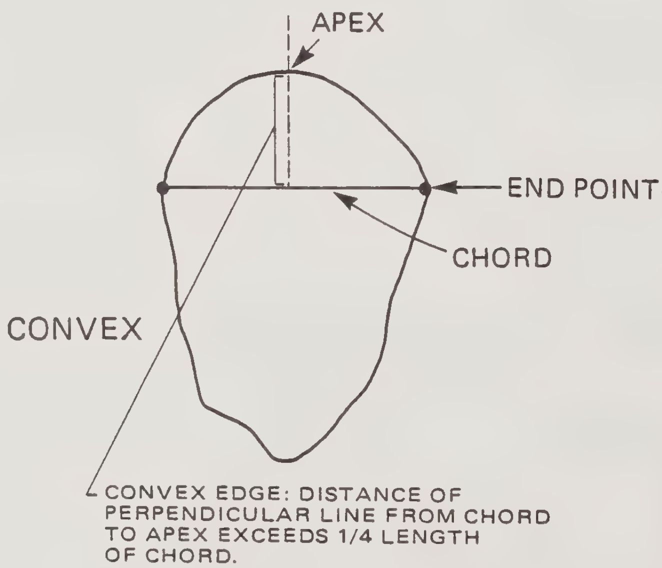
DEFINITIONS

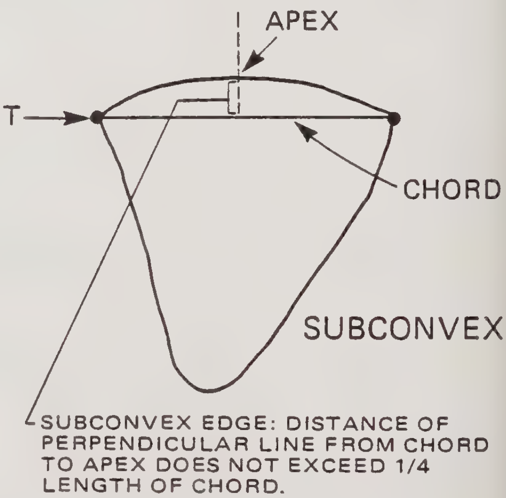
CONCAVE VS. SUBCONCAVE: A concave edge describes a concave line between the two end points of an edge where a perpendicular line constructed from the chord to the apex of the arc exceeds one-fourth the length of the chord which is drawn through the end points of the edge.



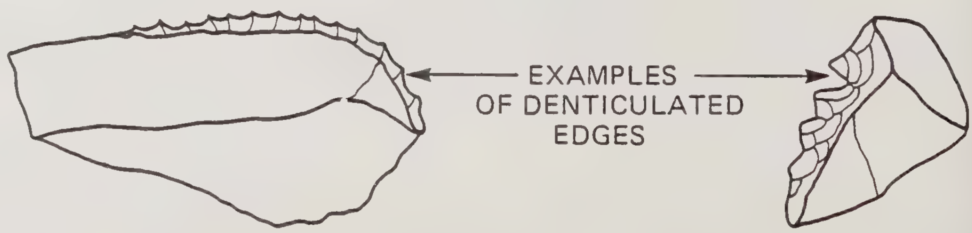


CONVEX VS. SUBCONVEX: Same relationship holds as described above, but position of chord is inverted:

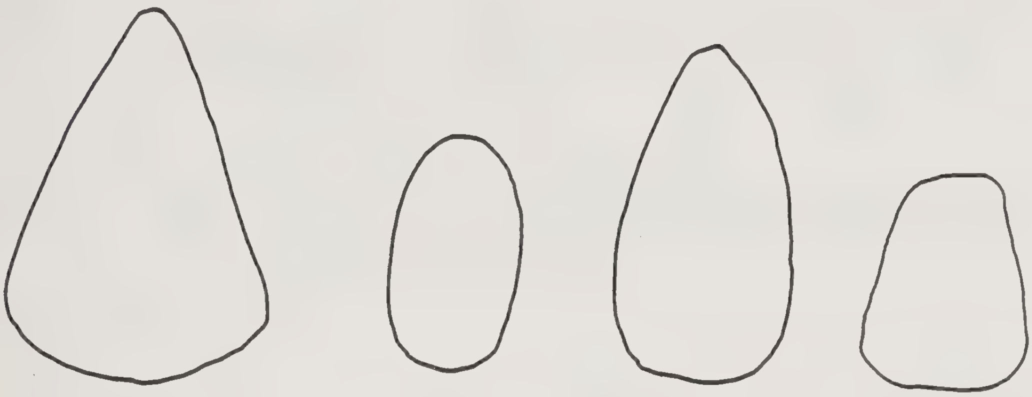




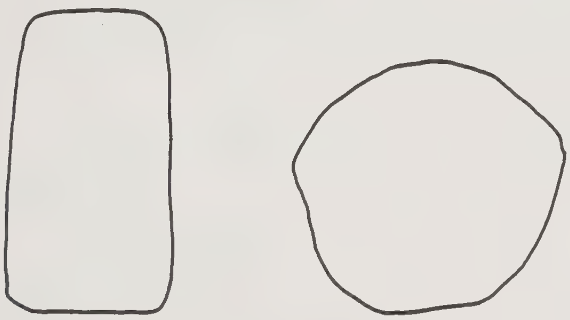
DENTICULATED: An edge exhibiting prominences similar to the teeth of a saw.



9. TOP VIEW OUTLINE:

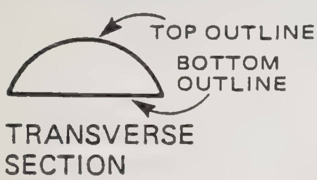


TRIANGULAR: 1 OVAL: 2 DISCOIDAL: 3 TRAPEZOIDAL: 4



SUBRECTANGULAR: 5 SEMICIRCULAR: 6 IRREGULAR: 7

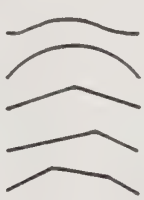
10. TRANSVERSE SECTION – BOTTOM OUTLINE: Transverse section bisects and is perpendicular to the longitudinal axis of the item.



PLANO: 1
SUBCONVEX: 2
SUBCONCAVE: 3
CONCAVO-CONVEX: 4
EXPANDING SUBCONCAVE: 5

11. TRANSVERSE SECTION – TOP OUTLINE

MEDIAN-RIDGED CONVEX: 1
CONVEX: 2
ISOSCELES TRIANGULAR: 3
NON-EQUILATERAL TRIANGULAR: 4
UNEQUAL QUADRILATERAL: 5



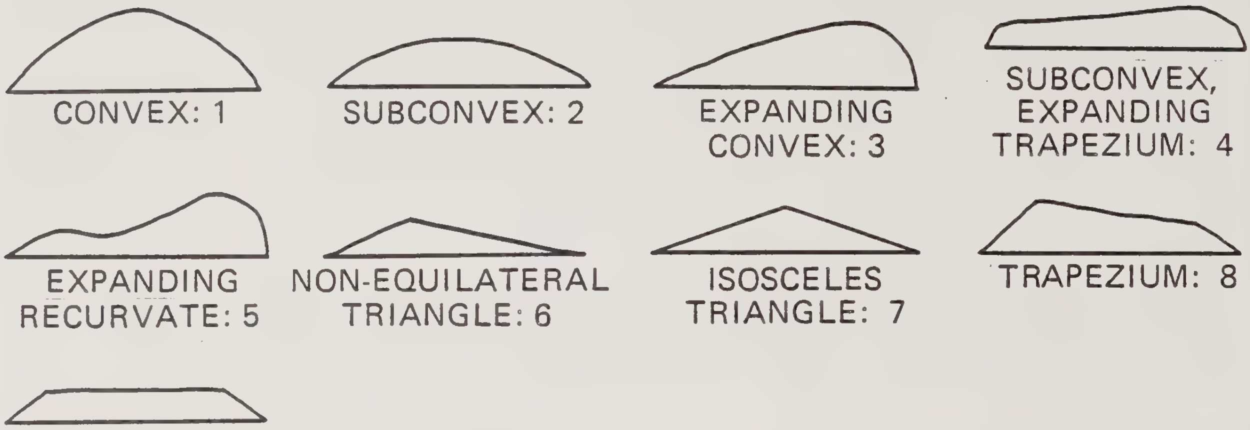
SUBCONVEX: 6

AMORPHOUS: 7

12. LONGITUDINAL SECTION – BOTTOM VIEW: Longitudinal axis of item

PLANO: 1
SUBCONVEX: 2
SUBCONCAVE: 3
CONCAVO-CONVEX: 4
EXPANDING SUBCONCAVE: 5

13. LONGITUDINAL SECTION – TOP VIEW



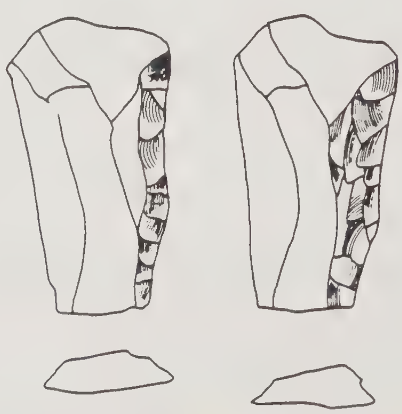
IRREGULAR: 10

14. **PRESENT/ABSENCE OF PRIMARY SCAR SHAPING:** Distinguished from flake scars resulting from reduction processed prior to the detachment of the tool blank from a core. Primary scars adjacent to the Dorsal/Ventral Juncture should exhibit the negative bulb of percussion. Recorded for all four sides.

ABSENT: 0
PRESENT: 1
INDETERMINATE: 2

15. **MARGINAL RETOUCH TYPE:** Retouch scars that extend from the edge perimeter for less than 1/3 of either surface.
- 0: ABSENT
- 1: UNIDIRECTIONAL = Marginal retouch extending from edge perimeter over only one surface of the flake.
- 2: BIDIRECTIONAL = Marginal retouch extending from edge perimeter over both the dorsal and ventral surfaces of the flake.

16. **MARGINAL RETOUCH TECHNIQUE:**
- 0: ABSENT
- 1: UNSTEPPED – Only a single row of retouch scars.
- 2: STEPPED – Several rows of concoidal scars at a steep angle.

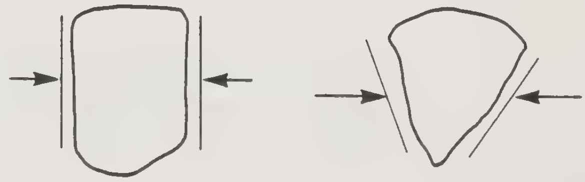


UNSTEPPED STEP

17. PRESENT/ABSENCE OF HAFT ELEMENT:

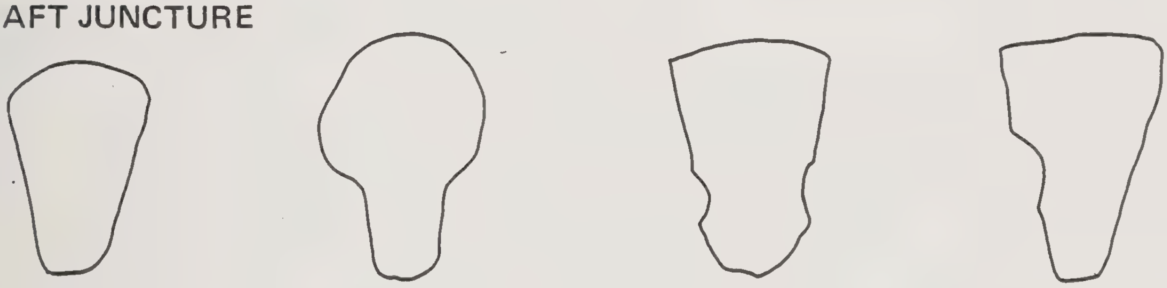
0: ABSENT
1: PRESENT

18. TANG FORM: (Relationship of Lateral Edges)



0: ABSENT 1: PARALLEL 2: CONTRACTING

19. HAFT JUNCTURE



0: ABSENT 1: SHOULDERED 2: BILATERAL NOTCHED 3: UNILATERAL NOTCHED

20. TOOL COMBINATION TYPE

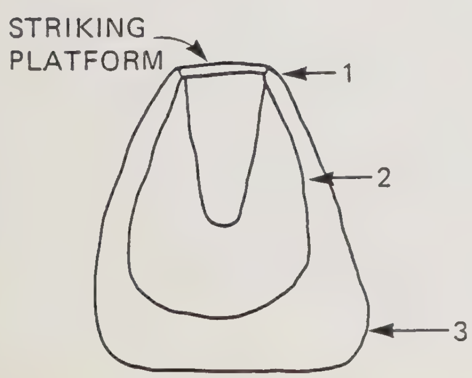
0: ABSENT
1: PROJECTION (Graver)
2: DOUBLE PROJECTION (Opposing Gravers)
3: BURIN
4: AWL

21. PLACEMENT OF TOOL COMBINATION (Edge)

0: ABSENT
1: DISTAL END
2: LEFT LATERAL SIDE
3: RIGHT LATERAL SIDE
4: PROXIMAL END

22. LENGTH OF UTILIZED OR RETOUCHED EDGE: All edges exhibiting utilization damage or retouch with utilization damage are measured. Length for utilization is determined by distance between the two most distant nibble or step scars along the edge.

23. MAXIMUM WIDTH POSITION



24. MAXIMUM WIDTH – Millimeters

25. MAXIMUM LENGTH – Millimeters

26. MAXIMUM THICKNESS – Millimeters

27. WEIGHT – Grams

28. EDGE ANGLES – Three measurements on each utilized or marginally retouched edge

CORE ANALYSIS CODING SHEET

VAR 1 RAW MATERIAL TYPE:

VAR 2 CONDITION:

1. WHOLE
2. BROKEN — The general form of the core is discernible, but portions of it are missing which makes complete measurement of some of the variables impossible.
3. INDETERMINATE — An amorphous piece of material deriving from a core. Usually a core fragment that does not retain adequate information to characterize a specific core type.

VAR 3 CORE TYPE: **For Whole & Broken Cores Only**

1. UNI-DIRECTIONAL — Flake scars originate from one platform surface and indicate flake detachment from only one direction (Crabtree 1972:97); refer to Var. 6-C.
2. BI-DIRECTIONAL — Flake scars exhibit evidence of flake removal in two directions. Scars can originate from one platform or two separate ones (Crabtree 1972:38); refer to Var. 6-B, E, and F.
3. MULTI-DIRECTIONAL — Flake scars exhibit evidence of flake removal in three or more directions (Crabtree 1972:78); refer to Var. 6-A and D.
4. BI-POLAR — A specialized core form produced by repeated blows to a nucleus of material resting on an anvil so that the axis of percussion is parallel to the vertical axis of the nucleus (Binford and Quimby 1963:277).

VAR 4 NUMBER OF PLATFORMS:

Record the number of individual platforms on the core. A platform is a relatively flat area on a core which can either occur naturally or can be prepared by initial flake detachment(s), and which has at least one flake scar originating at its margin and extending onto an adjacent face (see Chapman 1977: 375).

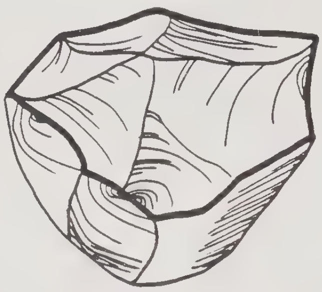
VAR 5 PLATFORM TYPE:

Record the type for each platform on a core. The core analysis form allows for up to 4 platforms on each core. It does not matter in which sequence platforms are analyzed, but each platform should be labeled on the core so that further analyses involving specific platforms are consistent (see Figure 1F for example).

1. CORTEX ONLY — This type of platform is wholly unprepared. The bulbs of flake scars abut an unaltered platform composed of cortex. Refer to Var. 6-B and F.1F. 1F.
2. UNIFACETED W/CORTEX — Platform exhibits minimal preparation consisting of the removal of only one flake. Cortex remains on a portion of the platform. Refer to Var. 6-C.
3. UNIFACETED — Platform exhibits minimal preparation consisting of the removal of only one flake, but cortex is absent.
4. MULTIFACETED — Preparation of platform resulted from the removal of two or more flakes. Refer to Var. 6-A and D.
5. ALTERNATELY FACETED — A specialized platform type resembling a biface reduction strategy. Generally associated with a bi-conical core (see Crabtree 1972: 39). In this case two adjacent platforms are alternately flaked to produce a sinuous aris that can be used to produce a lame a crete (see Crabtree 1972: 43) which is an initial blade by-product in the preparation of a blade core. Refer to Var. 6-E.

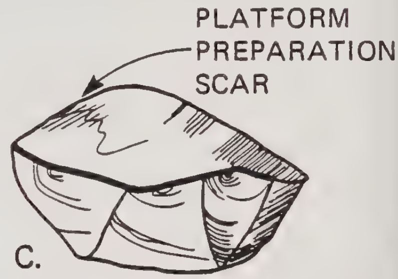
VAR 6 PLATFORM PERIMETER LENGTH:

The length of the perimeter of each platform as defined by the extent of contiguous flake detachment should be measured in millimeters. Examples of platform perimeter lengths are illustrated below. Dark lines indicate individual platform lengths.



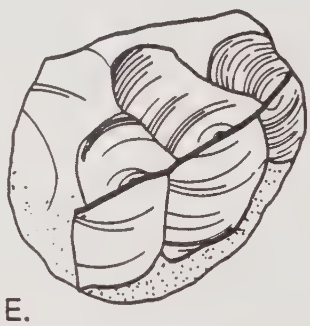
A.
ONE CIRCUMFERENTIAL PLATFORM – DISCOIDAL CORE

B.
TWO PLATFORMS – POLYFACETED BIDIRECTIONAL CORE

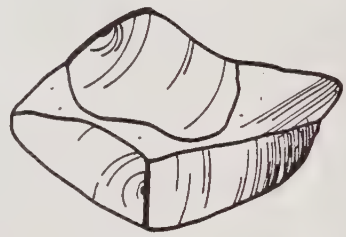


C.
ONE PLATFORM – UNIDIRECTIONAL CORE

D.
TWO PLATFORMS PICTURED – POLYFACETED MULTI-DIRECTIONAL CORE



E.
ONE, ALTERNATELY FACETED PLATFORM – POLYFACETED BIDI – RECTIONAL CORE



F.
TWO PLATFORMS – SIMPLE BIDIRECTIONAL CORE

Adapted From Isaac (1977: Fig. 55, Pg. 175)

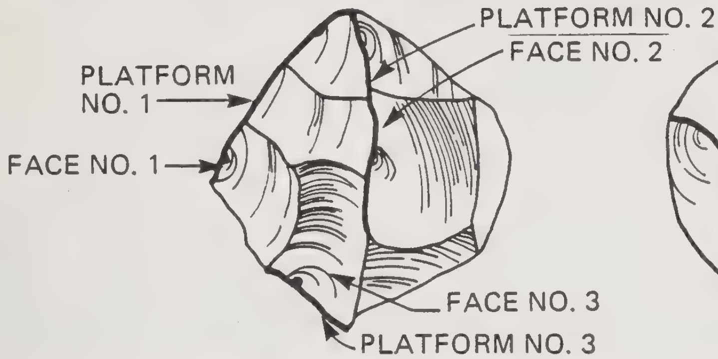
VAR 7 NUMBER OF STEP FRACTURE SCARS PER PLATFORM:

For each platform record the number of step fractures occuring along the perimeter. Step fractures on cores generally reflect unsuccessful percussive blows. Ultimately this measurement can provide an index of "exhaustion". Step fracture scars usually measure less than 5mm in length.

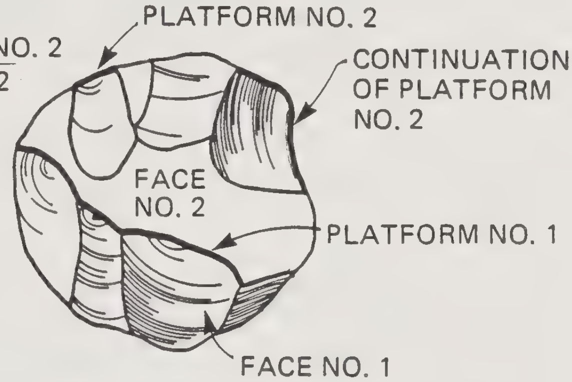
1. 0
2. 1 -10
3. 11-25
4. 26-50
5. 51-75
6. 76-100
7. 〉100

VAR 8 NUMBER OF FACIAL SCARS:

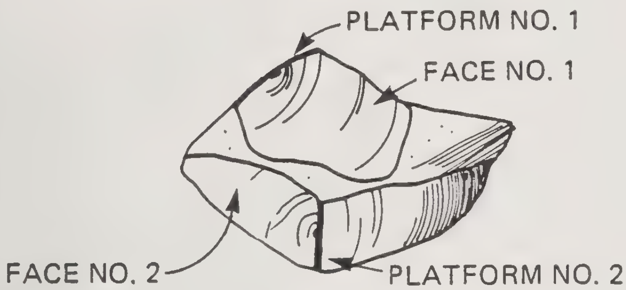
Record the number of flake scars present on each core face. A face corresponds to an area of flake scarring associated with and immediately adjacent to the perimeter of a striking platform. This associated striking platform serves as the point of origin for the flake scars which compose a particular face. For each striking platform there should be an associated face on a core. Thus, the number for a face should correspond to the number for its associated striking platform. That is, Face No. 1 should correspond with Platform No. 1. Examples of this are illustrated below.



A. MULTIDIRECTIONAL CORE (THREE PLATFORMS)



B. MULTIDIRECTIONAL CORE (TWO PLATFORMS)



C. SIMPLE BIDIRECTIONAL CORE (TWO PLATFORMS)

VAR 9 AVERAGE MAXIMUM LENGTH OF FACIAL SCARS:

Record the average length in millimeters for flake scars greater than 30 millimeters long for each face. Length of a scar is determined by measuring the distance between the platform and the base of the scar along the medial axis. Enter each individual flake scar maximum length measurement on a separate form.

VAR 10 AVERAGE MAXIMUM WIDTH OF FACIAL SCARS:

Record the average maximum width in millimeters for each scar greater than 30 millimeters in length for each face. Width is measured by a line drawn perpendicular to the medial axis used in determining length. Enter each individual measurement for scar width on the additional form as discussed for V8.

VAR 11 PERCENT CORTEX:

Record category corresponding to the percent of cortex remaining on the entire core.

1. No Cortex 2. 1 -25% 3. 26-50% 4. 51-75% 5. 76-100%

VAR 12 PRESENCE OF BATTERING

0 — Absent
1 — Present

VAR 13 LENGTH OF CORE:

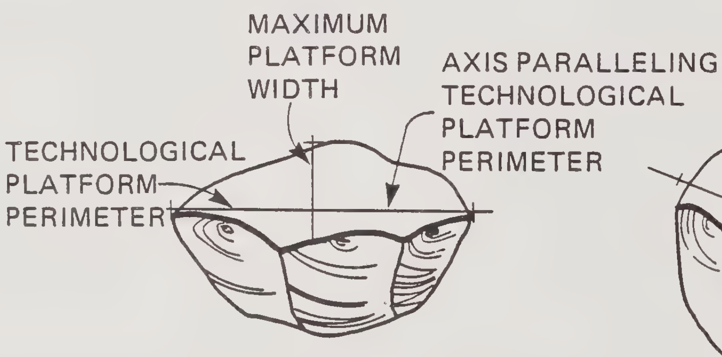
Maximum measurement of core, in any direction, in millimeters.

VAR 14 WIDTH OF CORE:

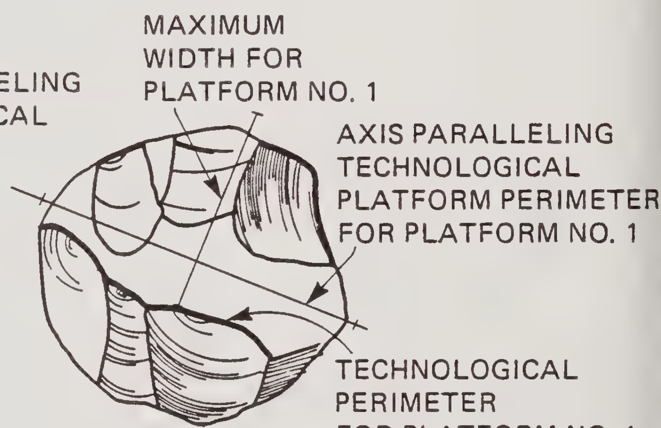
Minimum measurement of core, in any direction, in millimeters.

VAR 15 MAXIMUM PLATFORM WIDTH:

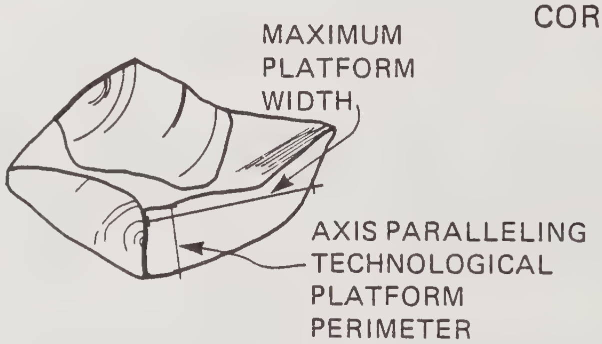
For each platform, measure area corresponding to the maximum distance between the technological (flaked) perimeter and the opposite end of the flat surface composing the platform. This measurement should be taken perpendicular to an axis paralleling the general direction of the technological platform perimeter. Recorded in millimeters.



A. UNIDIRECTIONAL CORE



B. POLYFACETED BIDIRECTIONAL CORE

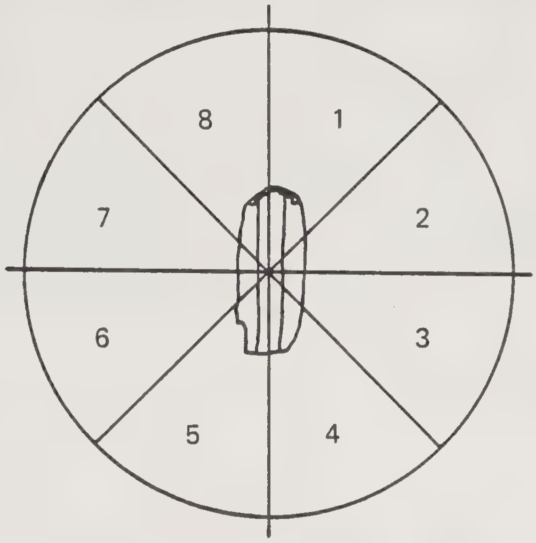


C. SIMPLE BIDIRECTIONAL CORE

VAR 16 WEIGHT OF CORE:

Measured in grams.

LITHIC USE-WEAR ANALYSIS CODING SHEET



EIGHT POLAR COORDINATE GRID.

A. LOCATION

Flake Ridge	1
Edge	2
Face	3
General	4

B. X-SECTION

Unmodified	1
Rounded	2
Faceted	3
Stepped	4
Concave (Facial Only)	5

C. OUTLINE

Regular	1
Irregular	2
Normalized	3

D. WEAR TYPE

Absent	00
Abrasive:	
Grinding	01
Blunting	02
Smoothing	03
Polishing	04
Flaking:	
Step	05
Crushing	06
Irregular	07
Hinge	08
Snap	09
Other:	
Striations	10
Pitting	11
Cone Fracturing	12

E. WEAR INTENSITY

Absent	0
Light	1
Moderate	2
Pronounced	3

F. PATTERNING

Striation Orientation: Degrees

0-30	01
31-60	02
61-90	03
91-120	04
121-150	05
151-180	06
181-210	07
211-240	08
241-270	09
271-300	10
301-330	11
331-360	12

FEATURE ANALYSIS CODING FORM

SITE NUMBER: Retain the last number only. Ex: 31CH8 = — 8 (Right Justify).

EXCAVATION LEVEL: N: Natural A: Arbitrary ie. = N — 2; N13; A — 1; A27

FEATURE CATEGORY:

1. Ash Lens
2. Rock Concentration
3. Ash/Rock Concentration
4. Basin Shaped Pit
5. Globular Pit
6. Fired Area
7. Cache
8. Sherd Concentration
9. Indeterminate Stain

CULTURE-HISTORIC ASSOCIATION:

1. Paleo-Indian
2. Dalton-Hardaway
3. Hardaway
4. Palmer
5. Early Kirk
6. Late Kirk
7. Bifurcate
8. Morrow Mountain
9. Guilford
10. Halifax
11. Savannah River
12. Transitional Stemmed
13. Yadkin
14. Woodland Stemmed
15. Uhwarrie
16. Late Woodland/Mississippian

FIRED STAIN; OTHER STAIN; DEPRESSION; FIRE-CRACKED ROCK; UNALTERED ROCK:

Absence: 0
Presence: 1

ARTIFACE AND ECOFACT ASSOCIATIONS: Absence = 0; Presence = 1

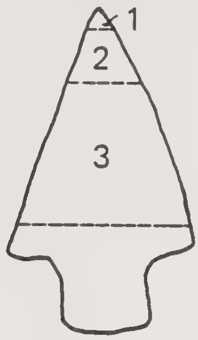
SITTING ON SILT BAND: No = 0; Yes = 1; Indet = 2

NUMBER SILT BANDS: Frequency of Bands Spatially Associated with Feature.

PROJECTILE POINT BREAKAGE PATTERNS

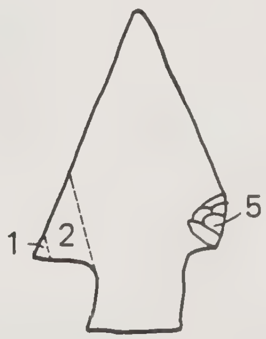
BLADE BREAKAGE

0 — NONE
1 — MOST DISTAL FACTURE — A tip fracture which does not exceed 2mm down the projected symmetry of the blade.
2 — SNAPPED TIP — A tip fracture which extends between 2 and 10mm down the projected symmetry of the blade.
3 — TRANSVERSE BREAK — A tip fracture which begins at a depth of greater than 10mm down the projected symmetry of the blade.



SHOULDER BREAKAGE

0 — NONE
1 — MOST DISTAL EAR FRACTURE — One shoulder ear is fractured at less than 2mm from the projected symmetry.
2 — EAR MISSING — One shoulder ear is fractured at greater than 2mm from the projected symmetry.
3 — MOST DISTAL EAR FRACTURE AND EAR MISSING — One ear is missing and the other ear exhibits a most distal fracture.
4 — TWO MOST DISTAL FRACTURES — Both shoulders exhibit most distal fractures.
5 — BOTH EARS MISSING — Both shoulder ears are missing.
6 — EAR(S) REWORKED — One or both shoulders exhibit evidence of retouch repair.



SHOULDER SYMMETRY

1 — SYMMETRICAL
2 — ASYMMETRICAL — Reworking has created unequal shoulder outlines.

HAFT BREAKAGE

0 – NONE – The tang is not fractured.
1 – SNAP – The tang is transversely broken.

BASE BREAKAGE

0 – NONE
1 – MOST DISTAL FRACTURE – One basal ear is fractured within 2mm or the projected symmetry of the base.
2 – EAR MISSING – One basal ear is fractured beyond 2mm of the projected symmetry of the base.
3 – MOST DISTAL FRACTURE AND ONE EAR MISSING
4 – TWO MOST DISTAL FRACTURES
5 – BOTH EARS MISSING

BASAL SYMMETRY

1 – SYMMETRICAL
2 – ASYMMETRICAL – The sides of the base are unequal due to the reworking of one side to repair a fracture.

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B. EVERETT JORDAN RESERVOIR
MITIGATION PHASE – HAW RIVER SITES

TOOL INVENTORY

Site No. 31Ch ____
Block A, B, C, D

Date	Initials	EU	LEV	Artifact No.	Description	Associations

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Site No. 31Ch ____

Block A, B, C, D

Excavation Unit ______________________ Level ______________________

Depth B. S. ______________________ Depth B. D. ______________________

Soil ____

____

Features present ____

____

Disturbances ____

____

Associations ____

____

Soil Sample? ________ Carbon? ________ Float? ________ Pollen? ________

Photos: ________ Roll ________ Frame(s) ________ BW ________ C ________

Excavated with: shovels ________ trowels ________ other ________

Screened with: 1/4" ________ fine ________ vol. sample? ________

No. bags ______________

Excavators ____

Date ______________________ Field note refs. ______________________

FLOOR PLAN ________ OR PROFILE ____ N E S W WALL (CIRCLE ONE)

E. U. ______________ Level ______________ Depth ______________ B. D. ______________

(Indicate scale, orientation and maximum dimensions)

Brief Description, Comments: ____

____

____

____

____

Symbols

△ PPK

☆ Biface

◪ Uniface

○ Rock

● FCR

+ Flake

⊠ Core

Charcoal

Fired ar

COMMONWEALTH ASSOCIATES INC.
B. EVERETT JORDAN RESERVOIR
MITIGATION PHASE – HAW RIVER SITES

Site No. 31Ch ____

Block A, B, C, D

Excavation Unit ____________________ Level ____________________

Depth B. S. ____________________ Depth B. D. ____________________

Soil ____

____

Features present ____

____

Disturbances ____

____

Associations ____

____

Soil Sample? ________ Carbon? ________ Float? ________ Pollen? ________

Photos: ________ Roll ________ Frame(s) ________ BW ________ C ________

Excavated with: shovels ________ trowels ________ other ________

Screened with: 1/4" ________ fine ________ vol. sample? ________

No. bags ________

Excavators ____

Date ____________________ Field note refs. ____________________

FLOOR PLAN ________ OR PROFILE ____ N E S W WALL (CIRCLE ONE)

E. U. ______________ Level ______________ Depth ______________ B. D. ______________

(Indicate scale, orientation and maximum dimensions)

Brief Description, Comments: ____

Symbols

△ PPK

☆ Biface

◩ Uniface

○ Rock

● FCR

+ Flake

⊠ Core

Charcoal

Fired area

APPENDIX 3

CERAMIC CODING VARIABLES

APPENDIX 3

TABLE 1: HAW RIVER CERAMIC VARIABLES AND DATA CODE CATEGORIES

VAR ID	COL(S)	FORMAT	VARIABLE	VARIABLE STATE CODES
VAR 1	Card 1: 1-4	F4.0	Sherd ID	1-9999
2	5-6	F2.0	State No. (NC)	31
3	7-8	F2.0	County No. (CH)	18
4	9-10	F2.0	Site No.	8, 29
5	11	F1.0	Excavation Block	1-9
6	12-13	F2.0	EU (Excavation Unit)	1-99
7	14-15	F2.0	Test Pit	1-99
—	16	1X	(Square — Recode on Card 2 = VAR 70)	
8	17-18	F2.0	Feature	1-99
9	19-20	F2.0	Level	1-99
10	21	F1.0	Vessel Part	1 = Rim Sherd 2 = Body Sherd 3 = Base Sherd
11	22-23	F2.0	Ext. Treatment Code	1-99, As Per Barnette (1978) Addendum IV
12	24 Card 1: 24	F1.0	Ext. Cord	1 = Noticeably Small Cord Size 2 = Avg. Cord Size 3 = Noticeably Large Cord Size
13	Card 1: 25	F1.0	Int. Cord	1 = Small 2 = Average 3 = Large
14	26	F1.0	Ext. Net	1 = Small 2 = Average 3 = Large

TABLE 1: HAW RIVER CERAMIC VARIABLES AND DATA CODE CATEGORIES (Cont'd.)

VAR ID	COL(S)	FORMAT	VARIABLE	VARIABLE STATE CODES
15	27	F1.0	Int. Net	1 = Small 2 = Average 3 = Large
16	28	F1.0	Ext. Rough	1 = Small 2 = Average 3 = Large
17	29	F1.0	Int. Rough	1 = Small 2 = Average 3 = Large
18	Card 1: 30	F1.0	Ext. Knotted Cord	1 = Small 2 = Average 3 = Large
19	31	F1.0	Int. Knotted Cord	1 = Small 2 = Average 3 = Large
20	32	F1.0	Ext. Fabric	1 = Small 2 = Average 3 = Large
21	33	F1.0	Int. Fabric	1 = Small 2 = Average 3 = Large
22	34	F1.0	Extra Ext. Multistate Treatment	1 = Small 2 = Average 3 = Large
23	Card 1: 35	F1.0	Extra Int. Multistate Treatment	1 = Small 2 = Average 3 = Large
–	36	1X	–	

TABLE 1: HAW RIVER CERAMIC VARIABLES AND DATA CODE CATEGORIES (Cont'd.)

VAR ID	COL(S)	FORMAT	VARIABLE	VARIABLE STATE CODES
24	37	F1.0	Ext. Plain	1 = Polished/Burnished; 2 = Slipped; 3 = Self-Slip; 4 = Brushed/Swiped; 5 = Tooled; 6 = Smoothed
25	38	F1.0	Int. Plain	1 = Polished/Burnished; 2 = Slipped; 3 = Self-Slip; 4 = Brushed/Swiped; 5 = Tooled; 6 = Smoothed
26	39	F1.0	Ext. Incised	1 = Present
27	40	F1.0	Int. Incised	1 = Present
28	41	F1.0	Ext. Punctate	1 = Present
29	42	F1.0	Int. Punctate	1 = Present
30	43-44	F2.0	Ext. Stamped	1-99 As Per Design Motifs
31	45-56	F2.0	Int. Stamped	1-99 As Per Design Motifs
32	47	F1.0	Ext. Applique	1 = Present
33	48	F1.0	Int. Applique	1 = Present
34	49	F1.0	Ext. Mounded	1 = Present
35	50	F1.0	Int. Mounded	1 = Present
36	51	F1.0	Ext. Pinched	1 = Present
37	52	F1.0	Int. Pinched	1 = Present
38	53	F1.0	Ext. Drag and Jab	1 = Present
39	54	F1.0	Int. Drag and Jab	1 = Present
40	55	F1.0	Extra Ext. Presence/Absence	
41	56	F1.0	Extra Int. Presence/Absence	
—	57	1X	—	
42	58	F1.0	Ext. Treatment Depth	1 = Shallow 2 = Medium 3 = Deep

TABLE 1: HAW RIVER CERAMIC VARIABLES AND DATA CODE CATEGORIES (Cont'd.)

VAR ID	COL(S)	FORMAT	VARIABLE	VARIABLE STATE CODES
43	59	F1.0	Int. Treatment Depth	1 = Shallow 2 = Medium 3 = Deep
44	60	F1.0	Ext. Smoothing over Treatment	1 = Present
45	61	F1.0	Int. Smoothing	1 = Present
46	62-63	F2.0	Lip Profile	1-99 Profile Codes
47	64	F1.0	Lip Elevation	1-9 Lip Form Codes
48	65	F1.0	Lip Treatment	1-9 Lip Treatment Codes
49	66	F1.0	Rim Form	1-9 Rim Form Codes
50	67	F1.0	Base Shape	1-9 Base Shape Codes
51	68-69	F2.0	Sherd Thickness (mm)	1-99
52	70-71	F2.0	Vessel Orifice Diam. (cm)	1-99
53	72-73	F2.0	Sherd Curvature (cm)	1-99
54	74-75	F2.0	Sherd Area (cm^2)	1-99
55	76	F1.0	Firing Technique	1 = Oxidized; 2 - Reduced; 3 = Reduced Core; 4 = Oxidized Core; 5 = Oxidized Interior; 6 = Oxidized Exterior
56	77-78	F2.0	Ext. Munsell Color Code	1-99
57	79	F1.0	Hardness	1 = Fingernail; 2 = Knifeblade; 3 = 〉2
58	Card 1: 80	F1.0	Sound	1 = Ring; 2 = Thud
VAR 59	Card 2: 1-4	F4.0	Sherd Id	1-9999
60	5	F1.0	Porosity	1 = High; 2 = Medium; 3 = Low (compact)
61	6	F1.0	Mixture of Clay	1 = Well (Absence of Lumps) 2 = Poorly (Lumps)

TABLE 1: HAW RIVER CERAMIC VARIABLES AND DATA CODE CATEGORIES (Cont'd.)

VAR ID	COL(S)	FORMAT	VARIABLE	VARIABLE STATE CODES
62	7	F1.0	Fracture Quality	1 = Even, Sharp Fracture 2 = Definite, but Irregular 3 = Crumble
63	8-9	F2.0	First Temper Agent	1-99 Type Code
64	10	F1.0	First Temper Size/Amt.	1-9 Combinations of Large, Medium, Small/Represented, Frequent, Abundant
65	11-12	F2.0	Second Temper	1-99 Type Code
66	13	F1.0	Second Temper Size/Amt.	1-9 Combinations of Large, Medium, Small/Represented, Frequent Abundant
67	14-15	F2.0	Third Temper Agent	1-99 Type Code
68	16	F1.0	Third Temper Size/Amt.	1-9 Combinations of Large, Medium, Small/Represented, Frequent, Abundant
69	17-18	F2.0	Int. Treatment Code	1-99 As Per Addendum IV
70	19-20	F2.0	Excavation Block	1-99

APPENDIX 3
TABLE 2
HAW RIVER CERAMIC BINARY VARIABLES

BINARY VARIABLE ID NO.	BINARY VARIABLE DESCRIPTION
1	Ext. Small Cordmarked
2	Ext. Medium Cordmarked
3	Ext. Large Cordmarked
4	Ext. Small Net
5	Ext. Medium Net
6	Ext. Large Net
7	Ext. Small Roughened
8	Ext. Medium Roughened
9	Ext. Small Fabric
10	Ext. Medium Fabric
11	Ext. Incised
12	Ext. Stamped: Sta. Line
13	Ext. Drag and Jab
14	Ext. Plain: Polished/Burnished
15	Ext. Plain: Brushed/Swiped
16	Ext. Plain: Tooled
17	Ext. Plain: Smoothed
18	Ext. Punctate
19	Ext. Shallow Treatment Depth
20	Ext. Medium Treatment Depth
21	Ext. Deep Treatment Depth
22	Ext. Smoothing Over Treatment
23	Int. Average Cord
24	Int. Small Fabric
25	Int. Medium Fabric
26	Int. Plain: Polished/Burnished
27	Int. Plain: Self-Slip
28	Int. Plain: Brushed/Swiped
29	Int. Plain: Tooled
30	Int. Plain: Smoothed
31	Int. Incised
32	Int. Shallow Treatment Depth

TABLE 2
HAW RIVER CERAMIC BINARY VARIABLES (Cont'd.)

BINARY VARIABLE ID NO.	BINARY VARIABLE DESCRIPTION
33	Int. Medium Treatment Depth
34	Int. Deep Treatment Depth
35	Lip Profile: Pinched
36	Lip Profile: Rounded
37	Lip Profile: Folded
38	Lip Profile: Flattened
39	Lip Profile: Thinned from Inside
40	Lip Elevation: Scalloped
41	Lip Elevation: Level
42	Lip Treatment: Pt. Punctated
43	Lip Treatment: Incised
44	Lip Treatment: Plain
45	Lip Treatment: Notched
46	Lip Treatment: Cordmarked
47	Rim Form: Straight
48	Rim Form: Slightly Excurvate
49	Rim Form: Slightly Incurvate
50	Sherd Thickness (cm): 5-6cm
51	Sherd Thickness (cm): 7cm
52	Sherd Thickness (cm): 8-9cm
53	Sherd Thickness (cm): 10cm
54	Sherd Thickness (cm): 10-17cm
55	Orifice Diameter (R, cm): 8-14cm
56	Orifice Diameter (R, cm): 16-20cm
57	Orifice Diameter (R, cm): 22-30cm
58	Orifice Diameter (R, cm): 32-38cm
59	Orifice Diameter (R, cm): 40-99cm
60	Sherd Curvature (R, cm). 8-14cm
61	Sherd Curvature (R, cm). 16-20cm
62	Sherd Curvature (R, cm): 22-30cm
63	Sherd Curvature (R, cm): 32-38cm
64	Sherd Curvature (R, cm): 40-99cm
65	Sherd Area (cm^2): 2-3cm
66	Sherd Area (cm^2): 4-5cm
67	Sherd Area (cm^2): 6-7cm

TABLE 2
HAW RIVER CERAMIC BINARY VARIABLES (Cont'd.)

BINARY VARIABLE ID NO.	BINARY VARIABLE DESCRIPTION
68	Sherd Area (cm^2): 8-10cm
69	Sherd Area (cm^2): 11-99cm
70	Firing: Oxidized
71	Firing: Reduced
72	Firing: Reduced Core
73	Firing: Oxidized Core
74	Firing: Oxidized Interior
75	Firing: Oxidized Exterior
76	Ext. Munsell: 5 yr Yellow/Red
77	Ext. Munsell: 7.5 yr Brown
78	Ext. Munsell: 10 yr Gray Brown
79	Ext. Munsell: 10 yr Yellow Brown
80	Hardness: Fingernail
81	Hardness: Knifeblade
82	Porosity: High
83	Porosity: Medium
84	Porosity: Low (compact)
85	Clay Mixture: Well (No Lumps)
86	Clay Mixture: Poor (Lumps)
87	Fracture: Even, Sharp
88	Fracture: Definite, Irregular
89	Fracture: Crumble
90	Quartz: S-R
91	Quartz: S-F
92	Quartz: S-A
93	Quartz: M-R
94	Quartz: M-F
95	Quartz: M-A
96	Quartz: L-R
97	Sand: S-R
98	Sand: S-F
99	Sand: S-A
100	Sand: M-R
101	Sand: M-F
102	Sand: M-A

TABLE 2
HAW RIVER CERAMIC BINARY VARIABLES (Cont'd.)

BINARY VARIABLE ID NO.	BINARY VARIABLE DESCRIPTION
103	Shell: M-F
104	Grog: M-F
105	Grog: L-F
106	Feldspar: S-R
107	Feldspar: S-F
108	Feldspar: S-A
109	Feldspar: M-R
110	Feldspar: M-F
111	Feldspar: M-A
112	Feldspar: L-R
113	Steatite: M-F
114	MICA: S-R
115	GRIT: S-F
116	GRIT: M-R
117	GRIT: M-F
118	GRIT; L-R
119	No Temper

S = Small
M = Medium
L = Large

R = Represented
F = Frequent
A = Abundant

APPENDIX 3
TABLE 3
CERAMIC ARTIFACTS FROM 1974 HAW RIVER ARCHEOLOGICAL INVESTIGATIONS — UNIVERSITY OF NORTH CAROLINA

Site	Square	Level	Accession No.	No. of Sherds
31Ch29	90R120	Plowzone	2309p.227	9
31Ch29	80R90	Plowzone	2309p.23	95
31Ch29	110R90	Plowzone	2309p.340	14
31Ch29	120R110	Plowzone	2309p.543	15
				133 Sherds

APPENDIX 4

NATURAL SCIENCE METHODS

Radiocarbon Analyses
Thermoluminescent Samples
Lithology and Classification of Haw River Materials

APPENDIX 4
NATURAL SCIENCE METHODOLOGY

RADIOCARBON ANALYSES

Recovery of carbonized wood or other materials suitable for radiometric dating purposes is an uncommon occurrence in Piedmont sites, usually due to factors of erosion and exposure which preclude perservation of such materials. Very few dates are therefore available for purposes of archeological interpretation, except for the well-known published series of Coe (1964). The majority of dates, published or unpublished, derive from sites sealed within alluvial deposits or otherwise protected, as in the rare instances of rockshelter sites (Rice 1971).

Given the nature of soils and groundwater actions at the Haw River sites, it was not surprising that preserved, carbonized wood or other substances were elusive commodities. Few of the features (Chapter 7) discovered during our excavations at 31Ch29 and 31Ch8 yielded sufficient amounts of carbonized material to permit accurate dating. Reasonable precautions were taken during the excavation of arbitrary and natural levels to identify and isolate all features, and special attention was given to those which presented even the slightest trace of ash or charcoal. Unfortunately, even those features appearing as dark grey or black fire stains produced too little dateable material.

Removal and storage of potential dating materials followed standard archeological practices. Visible pieces of burned wood were removed using clean trowels and placed directly in aluminum foil containers, where they remained until transported eventually to Commonwealth's Jackson laboratory. Organically stained soils from features were bagged as volume fill samples of at least .5 1 (depending on the feature dimensions).

Attempts were made both in the field and laboratory to divide carbonized materials from soil matrices by water separation (flotation). Experimenting with portions of larger feature fill samples, we initially attempted to segregate materials using the time-honored

washtub and strainer method, with the Haw River as a water source. With few exceptions, those efforts failed, due mainly to the very fine particle size of carbonized plant remains.

Water separation under more controlled conditions in the Jackson laboratory facility also met with limited success. Chemical separation of feature fills into various components using zinc chloride solutions likewise failed to achieve adequate recovery rates and efforts to mechanically isolate charcoal samples from feature fill samples were abandoned as too time-consuming and basically non-productive.

Eventually we resorted to re-examining and selecting samples for radiocarbon dating from among the less diffuse categories of featural samples, supplemented by a few samples processed by gentle water-screening through fine-mesh Number 35 geologic screen. A total of 12 factors were judged equally important and no factor ranking samples were selected, based on judgements of size, carbon content and associational integrity. Six of the samples were derived from 31Ch8 deposits containing mainly Woodland components and the remaining six were taken from Early or Middle Archaic contexts at 31Ch29.

Samples were submitted to the laboratories of Beta Analytic Inc. of Coral Gables, Florida. Each was assigned an eight-digit identification code for internal control purposes. Broken into two digit segments, each sample control number contained provenience information (in order) on the site number, excavation unit, arbitrary level and feature number. For example, sample 08070606 came from 31Ch8, EU7, Level 6, Feature 6. Some samples were not derived from features but from general occupation floor fills that were water-screened; they lack feature numbers and include zeros as the last two code digits. One sample (29102167N) was recovered by waterscreening material from a feature encountered during natural level excavations in Block A, EU10 and is denoted by an "N".

Table 1 presents provenience (code number) data and radiocarbon dates for the twelve samples submitted from the 1979 Haw River excavations. Dates are uncorrected for tree-ring calibrations and were calculated using a Libby half-life of 5568 years and 95 percent of the activity of the NBS Oxalic acid as a modern standard.

Table 1
Radiocarbon Age Determinations for Samples from 31Ch8 and 31Ch29

Lab Number	Sample Code	C-14 Age Years B.P.
Beta-1356	08070606	insufficient carbon
Beta-1357	08070805	2190 ± 95 B.P.
Beta-1358	08071010	insufficient carbon
Beta-1359	08071100	insufficient carbon
Beta-1360	08080400	1305 ± 145 B.P.
Beta-1361	08090203	1885 ± 120 B.P.
Beta-1362	29031641	less than 145 B.P.
Beta-1363	29042031	5695 ± 280 B.P.
Beta-1364	29072800	insufficient carbon
Beta-1365	29073000	5425 ± 340 B.P.
Beta-1366	29083400	insufficient carbon
Beta-1367	29102167N	7960 ± 90 B.P.

A brief summary of information of the provenience and associational significance of each dated sample can now be provided.

Beta 1357. 2190 ± 95 B.P. The sample consisted of 172 gm of sandy feature fill containing a fragment of what appeared to be carbonized wood. The sample was associated with portions of two Woodland ceramic vessels, broken and placed in a refuse pit. The resultant archeological feature was labelled Number 5 for 31Ch8 and is described in Chapter 7. Discussion of the associated ceramic vessels also is included in Chapter 7.

Beta 1360. 1305 ± 145 B.P. An area of what was judged to be burned soil was sampled for this age determination. The sample provenience is EU8 of Block C, 31Ch8 and physically occurred in a natural soil level (Stratum 2) just below the disturbed root/humus zone at that site location (Chapter 7). No artifacts were found in direct association with the sample, although Stratum 2 produced a variety of Early Woodland ceramic and lithic items for which a date of approximately AD 500-790 would not be unreasonable.

Beta 1361. 1885 ± 120 B.P. This sample included several chunks of solid wood charcoal with some adhering soil matrix, weighing a total of 8.3 gm. Feature 3 has been interpreted as a basin-shaped hearth or refuse pit, containing ashy soil mixed with very small bits of unidentifiable animal bone and a few fragments of burned hickory nut shell. Associated artifacts include several fabric-impressed quartz-tempered sherds and a small triangular, Caraway-like arrow point (Chapter 7).

Beta 1362. Less than 145 B.P. One of few carbon samples obtained from 31Ch29, this consisted of over 15 gm. of carbonized plant remains isolated by waterscreening from the fill of an apparent hearth. Feature 41 was exposed in arbitrary Level 31 in Block A, associated stratigraphically with Palmer phase occupations. The disappointing radiometric age determination can only be attributed to some form of sample contamination, either during excavation and processing or by natural agencies (tree roots or ground water actions) while still in original soil contexts.

Beta 1363. 5695 ± 280 B.P. An unusually solid piece of wood charcoal weighing some 46.2 gm comprised the basis for this date. It was collected from an apparent hearth feature (Number 31) in Early Archaic Kirk contexts at 31Ch29. Feature elevation, relative to an arbitrary surface datum of 100m, was 97.95 m. and the single associated artifact was an nondiagnostic unifacial flake tool. The derived date of approximately 4025-3465 B.C. is obviously too recent for Kirk occupations in the Southeast (Chapman 1976) and must be considered incorrect.

Beta 1365. 5425 ± 340 B.P. Laboratory processing of a 204 gm. sample of burned soil mixed with dark ash yielded another aberrant date for Early Archaic occupations of 31Ch29. No feature number was assigned to the generalized area of ash stain from which the sample was derived. The depth (97.50 m) and general artifactual associations of this sample (Palmer/Hardaway) make it highly unlikely that this constitutes a correct date.

Beta 1367. 7960 ± 90 B.P. Water separation (flotation and screening) of Feature 67 matrix from 31Ch29 yielded sufficient carbonized plant remains for this date. Natural level excavations of EU10, Block A led to the definition of a large hearth area con-

taining small charcoal and fire cracked rock fragments. Associated artifacts in natural Level 21 have been grouped within the Lamella 8 occupation floor discussed in some detail in Chapters 7 and 12. The Bifurcate and late Kirk projectile point forms found in that zone can reasonably be accepted (Chapman 1975, 1976) to correlate with date in the 5830-5650 B.C. time range, marking the approximate archeological boundary between Early and Middle Archaic adaptational stages in the Piedmont.

THERMOLUMINESCENT SAMPLES

Three lithic samples were collected from a suspected hearth and prominent rock cluster at site 31Ch29 to determine:

1) the extent and nature of possible heat treatment
2) the dates of heat treatment and, therefore, utilization of the site

Sample provenience was carefully noted to maintain strict stratigraphic controls; this was especially crucial at 31Ch29 where complex relationships between lamellar silty-sands and interlamellar sands complicated identifications of occupation floors. The collected samples all came from the rock concentration at EU2, Block A, levels 16-17, at a depth of c. 80 cm below the surface. The location of the sample and its relationship to the complex stratigraphy at 31Ch29 is shown in Figure 9.4. Collection was made in December of 1979 and samples were submitted to Dr. R. Rowlett of the Thermoluminescence Laboratory, University of Missouri-Columbia, in February 1980.

In accordance with standard procedures (Rowlett, 1977) three samples were taken. Lithic raw materials were river derived and were identified in the field as "metaigneous river cobbles"; associated soil samples were alluvial sands whose origins are overbank deposits of the Haw River.

Both heating and dating procedures were applied to the samples since they were all apparently derived from the hearth. Determinations were made on the basis of distinctive glow patterns characteristic of particular lithic types heated to given temperatures. Of the three Haw River samples examined, the following results were obtained:

Sample No.	Date	Temperature Range of Heated Samples
1	7450±750 B.C.	200-400°C
2	〉15,000 B.C.	250-350°C
3	6500±660 B.C.	200-380°C

Only sample No. 2 was apparently derived from an indeterminate source since it featured an anomalous glow pattern; it was considered unreliable and was not calibrated with the others. Both samples 1 and 3 displayed consistent glow peaks, but their temperature ranges varied significantly; standard deviations are on the order of ten percent. Incorporating these two age determinations with the stratigraphy, it is seen (Figure 9.4) that the rock cluster itself is associated with lamella 7/6 (see Chapter 9). It is stressed that the lenticular and discontinuous distributions of these lamella often obscure absolute stratigraphic relationships, but in this case diagnostic artifacts have been attributed to the specific occupation — 2 — and floor. The assemblage is characterized by small Kirk corner-notched, LeCroy bifurcated stem, Kirk stemmed, and Stanly cluster point types. Equivalent strata were not dated by other means. A radiocarbon sample was processed from 31Ch29 provided a date of 7960±90 B.P. (6000 B.C.) for the St. Albans and Kirk corner-notched point horizon associated with lamella 8. As Figure 9.4 shows this stratigraphic unit immediately underlies lamella 7/6. The thermoluminescent dates therefore appear to be somewhat early, but sample 3, with its relatively high standard deviation, overlaps with the upper range of the dated occupation at lamella 8. In general both of the thermoluminescent dates — i.e., samples 1 & 3 — fall within the range of the "Kirk corner-notched cluster" as defined by Chapman (1977:161-163) for Early Archaic sites in the southeast. Clearly, the accuracy of the thermoluminescent dates cannot be accurately gauged in the absence of more reliable radiometric indicators for the given strata sampled.

LITHOLOGY AND CLASSIFICATION OF HAW RIVER RAW MATERIALS

This section is intended to serve two major purposes. First, it provides detailed analyses and interpretations of the various lithic raw materials used for production of stone tools at the Haw River sites. The need for an accurate, replicable system of raw material identification cannot be overestimated when dealing with archeological assemblages composed

almost exclusively of stone tools. Study of prehistoric raw material selection patterns is predicated on the ability to recognize and categorize specimens of tools, debitage, etc. and further lends itself to functional studies of stone tool assemblages.

The second purpose of this report section is to disseminate a geologically accurate system of raw material classification that can be comprehended by archeologists and applied, for comparative purposes, to archeological collections from other areas of the Piedmont. The utility of any typological scheme is measured in terms of how well is serves the interests of researchers. A very real state of terminological confusion exists among Piedmont archeologists as they attempt to describe raw materials selected for tool production, to the point of making reports, and archeologists, mutually unintelligible. Ideally, widespread application of an accurate and understandable system of lithologic identification such as the one presented here can alleviate that confusion and permit researchers to concentrate on more substantive questions of regional archeological interpretation.

Lithic Material — Haw River

Lithic specimens from 31Ch29 and 31Ch8 were initially separated into 16 different material types, based on color, texture and obvious inclusions, that were labelled A through P. Stone tools and debitage were assigned to one of these categories and the letter was used to code material types for future analytic purposes. Thin sections were prepared and examined by L. H. Larsen of the University of Cincinnati for ten different material types with five additional samples of some of the same material (see Table 2). However, before describing these particular specimens, potential material source area and certain petrologic terms should be reviewed.

Brief discussion of the local geology is found in Chapter 6. As noted, Reinemund's (1955) geological analysis of the area immediately downstream from the project area describes the bedrock geology in broad terms, with emphasis on the Triassic strata. However, for our purposes, discussion of Reinemund's (1955:23) "Pre-Triassic Rocks", specifically the Carolina Slate Belt, is important. Subsequent research in the slate belt region of North and South Carolina (Butler 1964, Bell, Butler, Howell, and Wheeler 1974, Butler and Howell

Table 2

Lithological characteristic of Haw River Rock Types

	Essential Minerals	Potash Feldspar > 2/3 Total Feldspar Quartz > 10%	Feldspathoid < 10% Quartz < 10%	Feldspathoid > 10%	Potash Quartz > 10%	Feldspar 1/3 – 2/3 Total Feldspar Quartz < 10% Feldspathoid < 10%	Feldspathoid > 10%
	Major Minerals		Hornblende, Biotite, Pyroxene, Muscovite			Hornblende, Biotite, Pyroxene	
	% Mafic (Dark) Minerals	10	15	20	20	25	30
	Chemical Composition SiO_2	71.5%	60.4%	56.0%	66.8%	57.0%	54.1%
	Al_2O_3	14.0%	17.0%	19.2%	15.8%	17.1%	21.0%
	Minor % of Others						
PHANERITIC	Equigranular	Granite					
PHANERITIC	Batholiths, Stocks						
PHANERITIC	Thick Dikes, Sills						
PORPHYRITIC	Phaneritic Groundmass						
PORPHYRITIC	Dikes, Sills, Margins						
PORPHYRITIC	Aphanitic Groundmass	Rhyolite	Trachyte			Latite	
PORPHYRITIC	Dikes, Sills, Surface Flows	Porphyry	Porphyry			Porphyry	
PORPHYRITIC	Margins, Welded Tuffs						
APHANITIC	Microcrystalline	Rhyolite	Trachyte			Latite	
APHANITIC	Dikes, Sills, Surface Flows						
APHANITIC	Margins, Welded Tuffs						
APHANITIC	Glassy	Obsidian					
APHANITIC	Surface Flows, Margins – Dikes, Sills,						
APHANITIC	Welded Tuffs						

			Plagioclase Feldspar > 2/3 Total Feldspar Potash Feldspar < 10% Total Feldspar			
Potash Feldspar > 10% Total Quartz > 10%		Sodic Piagioclase Quartz > 10%	Quartz < 10% Feldspathoid < 10%	Calcic Piagioclase Quartz < 10% Feldspathoid < 10%	Feldspathoid > 10% Pyroxene > 10%	
			Hornblende, Pyroxene, Biotite, Pyroxene, Uralite, Olivine			
20		20	25	50	60	
65.3%		61.6%	58.2%	46.8%	47.4%	
16.1%		16.2%	17.0%	16.8%	15.4%	
			Diorite	DIABASE		
			Diorite Porphyby			
	Dacite		Andesite	Basalt		Trap — Dark-Colored
	Porphyry		Porphyry	Porphyry		Aphanitic Rock
	Dacite		Andesite	Basalt		Felsite — Light-Colored Aphanitic Rock

Source: Redrawn from Travis (1955:Classification of Igneous Rocks)

1976, Conley 1962, Conley and Bain 1965, Sundelius 1970), and specifically the U.S. Army Corps of Engineers 1965, describes these rocks in greater detail. When examining prehistoric lithic procurement within the project area, one important point must be kept in mind. As Butler and Ragland (1969:701) argue:

> Rocks of the Carolina Slate Belt are mainly low-rank metamorphic rocks of sedimentary and volcanic origin. The most common types are phyllite, argillite, graywacke, tuff, breccia, and volcanic flows of rhyolitic and basaltic composition. Slate is not widespread in the Carolina slate belt, but the name of the belt is retained because it is firmly entrenched.

In a similar manner Sundelius (1970:352) prefaces his discussion, stating:

> Carolina slate belt is a geologic term not wholly accurate but honored by tradition... Indeed, the rocks are not even composed largely of slate. As presently used, the term slate belt refers to greenschist grade, generally finegrained volcanic and sedimentary rocks of probable early Paleozoic age.

Consequently it is not surprising that petrographic reports south of the project area (U.S. Army Corps of Engineers 1965, Appendix I) include such "metavolcanics." Rock cores south of the project area were described well and mineral compositions were presented. Metavolcanic rocks found during the Corps stress tests include porphyritic metadacite, metabasalt, metafelsite, and basalt. "Meta" is simply a prefix indicating that igneous or sedimentary rocks have been metamorphosed.

Proposed bedrock relationships of the Carolina Slate Belt within the site locality are illustrated in Figure 6.2. Exposure and availability of these metavolcanic materials in the immediate site area along the Haw River valley have varied through time. However, exposures are accessible in adjacent areas and cobbles are found within the major and tributary stream beds, providing several alternative sources for lithic procurement other than bedrock exposures.

Rocks in the Carolina Slate Belt include igneous rocks formed from silica rich magmas. Rate and conditions of the cooling process determine the rock composition and the subse-

quent descriptive names given them by geologists. Therefore, considerable variation within rock across a region can be expected (Spock 1953:47-54, 88-90; V. Howell, Turner and Gilbert 1954:3-36). Quickly cooled igneous rocks with very fine texture and microscopic grains are referred to as aphanitic. Those that cool slowly and exhibit well-formed mineral crystals, or phenocrysts, within an aphanitic ground mass or matrix, are termed porphyritic. Descriptive names of igneous rocks are closely related to grain size (Travis 1955; Spock 1953; Howell, Turner and Gilbert 1954).

Metamorphism of igneous and sedimentary rocks within the Carolina Slate Belt is an important component in understanding the petrographic descriptions of the Haw River lithic materials. Metamorphism involves alteration of rocks in solid states through changes in the conditions of temperature, pressure, or fluids (Spock 1953:228-229; Howell, Turner and Gilbert 1954:161-166).

The slate belt predominantly reflects low/medium grade, greenschist facies metamorphism. Minerals diagnostic of the greenschist facies include muscovite, chlorite, quartz, and epidote and are found in many of the thin sections. Therefore a discussion of these will facilitate interpretation of the thin section descriptions. The following descriptions are taken from Deer, Howie, and Zussman (1966:204-5, 231-240, 61-67).

Muscovite $K_2\ Al_4\ [Si_6\ Al_2\ O_{20}](OH,F)_4$. Muscovite occurs in regionally metamorphosed rocks in the form of flakes or sheets in "books." Its color is generally clear or light green, red or brown.

Chlorite $(Mg, Al, Fe)_{12}\ [(Si, Al)_8\ O_{20}]\ (OH)_{16}$. Chlorite occurs in both igneous and basic metamorphic rocks and is often associated with epidote. Structurally, it is similar to mica, but may occur in forms other than platz books. Chlorite is green colored.

Epidote $Ca_2\ Fe^{+3}\ Al_2\ 0{\cdot}0H{\cdot}Si_2O_7{\cdot}SiO_4$. Formation of epidote is most common in regionally metamorphosed basic igneous rocks. Epidote is yellowish green to olive in color.

Many of the minerals found in slate belt rocks, such as chlorite and epidote, impart a green color. Another term used to describe minerals within the Haw River specimens, as well as rock samples from near the dam site (U.S. Army Corps of Engineers 1965, Appendix I), is pyroxenes. Pyroxenes are chain silicates having a composition of $Mg\ Si\ O_3$-$Fe\ Si\ O_3$ that occur in combination with calcium, sodium, and aluminum (Deer, Howie and Zussman 1966:99-135; Kerr 1959:302-318). Many of the pyroxenes form in igneous and metamorphic rocks. A number of these, including diopside and jadite are green in color.

The remaining common minerals in the assemblage include quartz and feldspar. Silica and water, SiO_2 are the major constituents of quartz, which is generally clear or white in hand specimen, although minor amounts of other minerals may impart rose, smokey, and blue colors (Deer, Howie and Zussman 1969:350-351). Feldspars (Deer, Howie and Zussman:281-338) are common constituents in igneous, metamorphic, and sedimentary rocks.

Alkali feldspars include both potassium and sodium, $(K_1\ Na)\ [Al\ Si_3\ O_8]$, and are usually white to pink in color. Plagioclase feldspars are dominated by sodium, $Na\ Al\ Si_3\ O_8$, and range from white to pale green in color. These are common in igneous rocks as phenocrysts and as aphanitic ground mass.

Relationships of Haw River rock types are illustrated in Table 2 (redrawn from Travis 1955). As noted above, the major characteristics of rock classification include texture or grain size (listed along the left margin — e.g., porphyritic, microcrystalline) and chemical composition (listed along the top margin with relative percentages of plagioclase, pyroxene, etc.). Here, potash feldspar is synonymous with alkali feldspar and feldspathoids are similar to feldspars in composition, but they are lower in silica content. Other terms that should be defined include felsite, trap, prophyry, aphanitic and phaneritic. Felsites are fine grained, light colored rocks that cannot be specifically assigned to a category because their exact mineral compositions are indeterminate. Trap rocks are the same except that they are dark colored. A porphry is an igneous rock with observable phenocrysts in a fine grained matrix. Aphanitic rocks are so fine grained that minerals can only be identified with the use of a microscope, while minerals in phaneritic rocks can be identified by the unaided eye.

TABLE 3

Descriptions of fifteen rocks by L. H. Larsen, University of Cincinnati.

General	—	All rocks submitted are metavolcanic, having been metamorphosed to the Greenschist Facies. They range in composition from latites to andesites, but it not possible to give an accurate classification since so few phenocrysts are present, most of them thoroughly altered. The range given above is approximately correct.
Specific		
Rm-A	—	Latite porphyry with flow-layering; probably a devitrified flow. Contains epidote, chlorite and muscovite as metamorphic minerals.
RM-B	—	Felsite; probably andesitic; was not originally glassy but had an original trachytic texture; contains abundant accessory magnetite; one quartz filled vesicle was seen; epidote occurs as veins and as replacement of feldspar; chlorite is a common replacement mineral for mafic phenocrysts.
RM-C	—	Probably a latite felsite; very few phenocrysts; appears to have a devitrified texture; no relic structures except one rock fragment; may have been a tuff; epidote and chlorite are common metamorphic replacement minerals.
RM-E	—	A latite porphyry; very similar to RM-A; has relic flow-layering; epidote and chlorite are common metamorphic replacement minerals.
RM-J	—	Glomeroporphyritic latite; similar to RM-A; has relic flow-layering; epidote and chlorite occurs as metamorphic replacement minerals.

TABLE 3 (Cont'd.)

Specific (Cont'd.)

RM-K	–	Devitrified felsite; possibly a tuff with relic shards; has metamorphic pyrite cubes with chlorite + quartz pressure shadows; epidote and chlorite are common metamorphic replacement minerals.
RM-L	–	Felsite, probably a latite; no phenocrysts; devitrified, contains epidote as a metamorphic replacement mineral.
RM-M	–	Porphyritic; probably andesitic; plagioclase phenocrysts heavily kaolinized; pyroxene phenocrysts now epidote and chlorite; abundant magnetite, some secondary, has relic flow layering; devitrified.
RM-N	–	Porphyritic; probably andesitic; has relic seriate texture; plagioclase phenocrysts are kaolinized; pyroxene phenocrysts are replaced by epidote.
RM-O	–	Porphyritic; probably a latite tuff; has both phenocrysts and rock fragments; plagioclase phenocrysts are kaolinized; epidote and chlorite are common replacement minerals.

Second Batch

RME	–	Devitrified tuff; phenocrysts and rock fragments occur with relic shards; probably a latite, epidote and chlorite are common metamorphic replacement minerals.
RMK	–	Felsite; only one phenocryst seen, no relic structures, has a fine, probably devitrified texture; contains abundant fine epidote but no apparent chlorite; may be a rhyolite.
RMAHR	–	Porphyritic; probably an andesite; plagioclase phenocrysts are replaced by epidote and pyroxene phenocrysts are replaced by chlorite and quartz; magnetite is common; has no relic primary structures or textures; probably devitrified.

TABLE 3 (Cont'd.)

Second Batch (Cont'd.)

RMAHRB-B	—	Felsitic; no phenocrysts; very fine-grained; has possible relic shards; devitrified; probably a welded-tuff; feldspars are kaolinized; some epidote and magnetite occurs.
RMAHR-C	—	A tuff with many rock fragments; much epidote and chlorite as metamorphic replacement minerals; probably an andesite.

Rock types from the Haw River assemblage will be described by hand specimen, with a Munsell color designation, followed by an interpretation of the thin section description. Larsen's laboratory report of the thin sections is available for inspection in Table 3.

Raw material A is greenish gray 5GY6/1 to 5Y6/1 in color. Fresh breaks are darker dark greenish gray, 5BG 4/1. In hand specimen the texture is a fine grained ground mass, with some faint, poorly developed banding. Phenocrysts range in color from glassy to white to rust while size is generally one millimeter or smaller, some are as large as four millimeters in maximum dimension.

Metamorphic minerals apparent in thin section include epidote, chlorite, and muscovite, accounting for the green color of the stone. Flow-layering is present and is interpretated as a devitrified flow. Devitrification of both basic and acidic tuffs involves alteration of glass and glass fragments to other minerals (Howell, Turner and Gilbert 1954:156-157). Alteration rate and minerals are dependent upon the compactness of the tuff as well as chemical composition of the ground waters. Based on the mineral composition observed by Larsen the rock was labelled a latite porphyry (see Table 3).

Raw material B is grayish green, 5G5/2, to dark greenish gray 5G4/1 in color. Compared to other materials in the assemblage, this has a relatively granular, coarse texture. Well formed, rectangular, green phenocrysts are present as well as olive colored veins. Cortex is highly weathered and mottled, generally a reddish yellow, 7.5YR6/6 with darker spots, dark brown 7.5YR3/2.

Two specimens from this category were thin sectioned. One is described as having a trachytic texture. Trachytes are common volcanic rocks and generally occur in association with basalt (Spock 1953:82-83, 138-139; Howell, Turner, and Gilbert 1954:94-101). These are rich in silica and felsic minerals, fine textured, with well-formed elongated phenocrysts of feldspar or other minerals. In the thin section magnetite and quartz were observed; epidote has replaced feldspar and also occurs as veins, and mafic minerals have been replaced by chlorite. This was analyzed as an andesitic felsite.

Raw material C is light olive gray 5Y6/2, and has a dull, opaque luster. It exhibits a fine, uniform, microcrystalline texture, however occasional well formed metalic phenocrysts of magnetite or weathered pynite also occur. There phenocrysts are very small, normally less than 1mm in size.

Material C was identified as a latite felsite or a tuff based on the absence of phenocrysts and devitrified texture. Metamorphic replacement minerals include chlorite and epidote.

Raw material D includes two different categories. The first is dark gray, N3/, fine grained, with some banding of mafic minerals; lighter gray lithic inclusions are also present. The rock has a light reflective sheen and is opaque.

The second type is dark greenish gray 5GY4/1. It also exhibits a sheen with a finer grained, cryptocrystalline texture. There are no apparent bands or flow structures, however some interior areas are weathered and exhibit well developed crystals. In thicker sections it is opaque, yet thin edges are translucent. Unfortunately, no thin section was made of the material. The hand specimens suggest the appearance of a tuff, perhaps a welded tuff, but without the thin section an exact classification is difficult.

In hand specimen, raw material E consists of three distinctive types. The dominant type is very dark gray, N3/, to black N2/. Flow banding, and lineation of felsic (light colored) minerals are apparent, particularly on weathered surfaces. White phenocrysts range in size from very fine inclusions, less than one millimeter, to larger ones as much a 3mm in maximum dimension.

The second type is very dark gray, N3/. There are no apparent phenocrysts, however some faint banding is present. It is quite similar to raw material D, having a fine grained texture, sheen, and translucence in thin specimens.

The third variety of type E is one of the more uncommon lithic materials in the assemblage. It is a very fine grained, cryptocrystalline, black, N2/ material. Texture is massive with no obvious structure and it is cherty in appearance. White to light gray phenocrysts are present and range in size from less than 1mm to 4mm.

Thin section E was done on the first type of rock. It is similar to lithic material A, exhibiting relict flow-layering which reflects its igneous origin. Epidote and chlorite are common as metamorphic replacement minerals. This was also identified as a latite porphyry.

Raw material F is white quartz. Abundant water bubbles present during the formation of the quartz as "hydrothermal veins" (Blatt et al. 1972:276-277) account for its white color. Additional trace minerals may add color to the quartz. In Piedmont soils quartz occurs as float (Camp et al. 1962:6), or rock fragments derived from weathered veins. Cobbles are also found in the Haw River. No thin section was examined since hand specimen identification was adequate.

Material G has a massive, fine grained groundmass, light gray, 5Y7/1; to gray 5Y6/1, in color. Large inclusions of gray (5Y5/1) clastics (broken rock fragments) ranging in size from 1mm to 15 cm and phenocrysts are present. It is dull and opaque.

The second G material is similar, yet has a slightly lavender cast. The groundmass of this lithic ranges from gray, 5YR6/1, to reddish gray 10R5/1. Rock inclusions are very dark gray N3/ to black N2 and range in size from less than 1mm to 1cm. Small phenocrysts smaller than 1mm are also present. Weathered cortex has a rusty, typical Piedmont appearance, ranging from light yellow brown, 10YR6/4, to yellowish brown 10YR5/4, 10YR5/6. Unfortunately, this material was not thin sectioned. Because the material has a light colored groundmass and phenocrysts, a safe descriptor would be felsic porphyry.

A distinguishing characteristic of raw material H is the high percentage of weathered cortex in relation to unweathered rock. Interior color is light brownish gray, 10YR6/2. It is fine grained, with some lineation of felsic minerals that are smaller than 1mm. It has a dull appearance and is opaque. Weathered cortex may attain a thickness of 1.3cm and ranges from very pale brown 10YR7/4, to yellow 10YR7/6. Without a thin section analysis the only descriptive name that could be applied is felsite, a light colored, aphanitic rock.

Raw material I has an almost cherty appearance. It has a massive cryptocrystalline texture, interrupted by well developed magnetite (?) crystals and dark green phenocrysts. The dominant color of the material is light greenish gray 5GY7/1, however, some specimens

are banded with a darker green, 5GY6/1, greenish gray. Since no thin section of material I was made, assignment to any specific rock type must remain felsite, however the descriptive terms light greenish gray are permissible.

Material J is similar to A, the green latite porphyry, however, it has more color gradations within the flow bands. Fresh surfaces are dark gray, N4/, and exhibit no structure. Flow bands are particularly obvious on weathered surfaces. The dominant color is greenish gray, 5GY6/1, and ranges to gray 5GY6/1 on weathered specimens. Flow banding encompasses a range of colors from 5GY6/1, greenish gray, to N4/, dark gray. Phenocrysts of quartz (?), less than 1mm in size, are abundant.

As with material type E, relict flow layering is visible in thin section in the gray latite porphyry. Metamorphic replacement minerals include epidote and chlorite. This material has been classified as a glomeroporphyritic latite. Glomeroporphyritic is an adjective used to describe an igneous rock texture in which the phenocrysts aggregate or cluster within the groundmass (Howell, Turner, and Gilbert 1954:19, 42).

Raw material K includes varying shades of brown, ranging from very pale brown, 10YR7/3 and 10YR7/4, l0YR6/3 pale brown, and 10YR6/4 light yellowish brown. This stone is fine grained, banded with elongated lineations of varying thickness, and shows well developed crystals of weathered pyrite and other minerals (possibly epidote) that are clear and dark green in color. These crystals range in size from less than 1mm to 1mm.

In thin section metamorphic pyrite was observed with chlorite and quartz pressure shadows. Pyrite porphyroblasts, are well formed metamorphic crystals derived from initially formed igneous phenocrysts. The quartz and chlorite then crystallize around the pyrite. Metamorphic replacement minerals include epidote and chlorite. Relic shards, small glass fragments that originally form in volcanic ash, were also observed. This material was assigned the name devitrified felsite.

Two major types compose Raw material L. In hand specimen, one looks purple or lavender, and as such is one of the more distinctive materials in the assemblage. The domi-

nant color is dark reddish gray, 10R4/1, which forms the fine grained groundmass of the stone. Reddish gray (10R6/1, 10R5/1) inclusions have the appearance of clasts, or rock fragments. However, in some specimens these inclusions exhibit what appear to be flow structure and vary considerably in size, often occurring in elongated or tear drop shapes. It is possible that as the surface weathers the lighter color becomes more pronounced. White and clear glass phenocrysts, possibly quartz, are present, along with small veins.

The second variety of material L is uniform in both color and texture. It is fine grained, but under magnification has a sugary, slightly granular appearance. No phenocrysts were observed in this section. It is devitrified and has epidote as a metamorphic replacement mineral. In thin section this sample was identified as a felsite, however descriptive color adjectives reddish gray may be used in conjunction with that term.

Lithic material M is another flow banded rock. Dark bluish gray, 5B4/1. Mafic bands alternate with light bluish gray, 5B7/1, felsic bands. Dark phenocrysts, smaller than 1mm occur within the bands. Other specimens have a slightly purple cast with greenish gray, 5G76/1, and reddish gray, 10R5/1, bands. These exhibit fine, microcrystalline texture, however, some mixing within the bands is apparent.

In thin section, material M was identified as an andesitic porphyry. It is devitrified and exhibits flow layering. Other evidence of metamorphism includes formation of epidote and chlorite from pyrite phenocrysts, magnetite, and kaolinization or weathering, of plagioclase phenocrysts. Material M was identified as an andesite porphyry.

Weathered exterior surfaces of raw material N are greenish gray, 5GY6/1, 5GY5/1. Cortex is apparent on some specimens; however, color varies, and is probably related in part to the presence of minerals such as pyrite and magnetite. Thickness of cortex varies but may reach 1.5 cm. Fresh, broken surfaces are dark greenish gray, 5G4/1, and no structure is apparent. Texture is microcrystalline. Banding is observable on some weathered specimens along with small (less than 1mm) dark colored phenocrysts.

Raw material O is characterized by two similar types of material. Both are fine grained, exhibiting a sugary or granular texture. The more siliceous type is translucent in thin speci-

mens and is a greenish gray, 5GY6/1. The second type is dull, opaque and greenish gray, 5G6/1, in color.

In thin section, both phenocrysts and rock fragments are apparent within type O specimens. Plagioclase phenocrysts are kaolinized while epidote and chlorite occur as metamorphic replacement minerals. Material O can be described as a latite tuff.

Compared to most of the Haw River lithic assemblage, raw material P is perhaps the most different in physical appearance and mineralogical composition. The dominant type within this category is cryptocrystalline, has a vitreous luster, and ranges in color from white to very dark gray, 5YR3/1, and dark reddish brown, 5YR3/2. Some specimens exhibit a mottled color. Unfortunately, none of these specimens was thin sectioned; the hand specimen examination, however, suggests that this material is a chert or chalcedony. Chert nodules generally form as water and silica available in the rock strata. The actual methods of chert formation have caused some controversy within the discipline of geology. Of particular interest here are possible inorganic origins of chert. Since the Carolina Slate Belt is of volcanic origin it is worth noting that silica in volcanic rocks is formed through the devitrification of volcanic glass fragments. As Blatt et. al. (1972:541) note:

> Where bedded cherts are intimately associated in the geologic record with volcanic detritus or pillow lava, however, the possibility of an inorganic source for the silica must be seriously considered.

If material P does not occur as a member of the local rock units, it may occur alternatively as cobbles within the Haw River drainage steam beds, or it may be of extra-local origin.

The other material in the P category is a chalky, dull, reddish gray (10R5/1) color. Under the microscope the stone has a sugary granular texture. Although it is extraordinarily fine grained, very minute laminations or bands are visible.

In summary, the predominant lithic raw material utilized by prehistoric occupants of the Haw River sites consisted of a highly variable assortment of metavolcanics. This variation basically results from differences in mineral composition, cooling conditions and local

forces of metamorphism. All of these lithic types are present in the immediate site area in the form of river cobbles or outcrops. Although this does not preclude the possibility that some of the artifactual material was procured from more distant regions of the Carolina Slate Belt, present knowledge of characteristics of lithic raw material sources in North Carolina is not adequate to evaluate such fine distinctions. Chert or chalcedony (Type P) is the only raw material type from the assemblage which reasonably may be considered to have an extra-local source. Even in this case, however, cryptocrystalline material is available in the form of small cobbles along the banks of the Haw River. Therefore, lithic source analysis cannot be considered definitive at this writing.

Categorization of artifactual materials into lithic types does provide an opportunity to examine diachronic patterns in raw material selection. One ubiquitous pattern is the tendency for earlier cultures to utilize higher proportions of fine grained, isotropic materials. Goodyear (1979) has discussed this pattern in some detail for the North American continent, and other researchers have noted similar utilization patterns in Australia (Gould 1980), Upper Paleolithic Europe (Renfrew et al. 1979) and the Near East (Renfrew 1973; Melart 1977; Kenyon 1971). Goodyear argues that greater proportions of highly isotropic lithics were selected as a response to the demands of high mobility. Materials that are extremely isotropic provide a greater degree of predictability or control during knapping and resharpening which, Goodyear argues, prolongs the use-life of tools. The Haw River lithic classification will be used to evaluate this pattern under conditions of maximum raw material availability.

In order to set the stage for this analysis, the raw material types were ranked according to their individual degree of isotropism (see table 4). This ranking was accomplished purely by visual inspection and assessment and is meant only as an approximate reflection of these qualities. Raw materials were placed in the following four categories for this purpose: low (1), moderate (2), high (3), and extremely high (4) isotropism.

TABLE 4

RANKINGS OF RELATIVE ISOTROPISM FOR THE HAW RIVER LITHIC CLASSES

Raw Material Class	Descriptive Name	Thin Section	Isotropic Ranking
A	Green Latite Porphyry	X	1
B	Andesitic Felsite	X	1
C	Latite Felsite/Tuff	X	3
D	Tuff (Welded?)		4
E	Grey Latite Porphyry	X	4
F	White Quartz		1
G	Felsic Porphyry		2
H	Brownish Grey Felsite		1
I	Light Greenish Grey Felsite		3
J	Glomeroporphyritic Latite	X	2
K	Devitrified Felsite	X	4
L	Reddish Grey Felsite	X	3
M	Andesitic Porphyry	X	1
N	Andesitic Porphyry	X	3
O	Latite Tuff	X	3
P	Chert/Chalcedony		4

APPENDIX 5

DATA ORGANIZATION

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Space limitations have precluded the inclusion in this report of listings of raw data used in the analyses presented in Chapters 9 and 12. These data are available to future researchers and are archived on computer tape or floppy disk. Full format details are contained in a guidebook curated with tape and disk. This appendix briefly describes the files available, the medium on which they reside, and the hardware and software that were used in implementation of the analyses for this report.

Data sets of three types are available: lithics and feature data, used for analyses in Chapter 9; ceramics data, as coded at Commonwealth for the spatial analysis of ceramics in Chapter 12; and assemblage composition data, used for the spatial analyses of 31Ch29 and 31Ch8 assemblages presented in Chapter 12. The first two groups of files contain attribute data for individual specimens; the third group contains frequencies data used in the spatial analyses.

LITHICS AND FEATURE DATA

Raw attribute data for the lithics and features analysis are contained in five separate files: projectile points (hafted bifaces), bifaces, unifaces (including marginally retouched flakes and utilized flakes), cores, and features. The codebooks for each file are presented in Appendix II. All files are formatted for use with SPSS (Nie et al. 1975). The SPSS data definition files are on tape with the data files themselves. These files were originally entered onto on-line hard disk at the University of Michigan Computing Center and were transferred to tape from disk; no cards are therefore available. All analyses were run using the University of Michigan's Amdahl 470 V/6 computer operating under the Michigan Terminal System (MTS).

CERAMICS DATA

Basic attribute data, including provenience, temper, size, and surface treatment, were coded for each sherd recovered at 31Ch8. These data are on tape and also are formatted for analysis using SPSS. The data definition file is entered on tape with the data. These files were entered from cards which are curated with the Haw River site group collections.

ASSEMBLAGE DATA

The assemblage data used in the spatial analysis are stored as frequencies of curated tools, expedient tools, and ceramics. These are contained in a series of files, one for each lamella (at 31Ch29) or stratum (at 31Ch8). The files were generated and the analyses run

on an Apple II+ microcomputer using programs written in BASIC specifically for this project. The files and the programs are stored on a 5¼" floppy disk that runs using Apple's DOS 3.3. Full documentation of the files, the programs to generate and retrieve the data files, and the program for the spatial analysis are found in the guidebook curated with the disk.


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